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Volume 1

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FOREWORD

In these volumes, we are very pleased to present a collection of papers based on talks and posters at Sinn und Bedeutung 22, which took place in Berlin and Potsdam on September 7-10, 2017, jointly organized by the Leibniz-Centre for General Linguistics (ZAS) and the University of Potsdam.

SuB22 received 183 submitted abstracts. Out of these, the organizing committee selected 39 oral presentations in the main session, 4 oral presentations in the special session ‘Semantics and Natural Logic’, and 24 poster presentations. There were an additional 6 invited talks. In total, 58 of these contributions appear in paper form in the present volumes.

We would like to take this opportunity to thank the many colleagues who helped to make SuB22 a success: our fellow organizers Guillermo Del Pinal, Mira Grubic, Manfred Krifka and Malte Zimmermann, without whom the conference would not have been possible; the nearly 200 reviewers from around the world; our invited speakers Márta Abrusán, Amy Rose Deal, Danny Fox, Hannes Leitgeb, Louise McNally and Philippe Schlenker; staff members Anja Gollrad, Ines Mauer and Azura Frömming, who dealt with countless practical details; our student assistants Carla Boos, János Litzinger, Norman Brackmann, Marius Küch and Henry Salfner, who ably supported us in the preparation phases and during the conference, as well as Meredith Alongi, Jordan Chark and Elizabeth Pankratz, who served as editorial assistants in the production of these proceedings; and of course the presenters, session chairs and audience members.

We would also like to acknowledge financial support from the Deutsche Forschungsgemeinschaft (grant KR 951/13-1), the Leibniz-Centre for General Linguistics, and the University of Potsdam, as well as surplus funds from SuB21 from the University of Edinburgh.

We look forward to seeing everyone in September 2018 in Barcelona for SuB23!

Berlin, July 2018

Uli Sauerland and Stephanie Solt
# Table of Contents

## Volume 1

**Foreword** ......................................................... i

**Table of Contents** .................................................. iii

**Márta Abrusán, Nicholas Asher and Tim Van de Cruys**  
*Content vs. function words: The view from distributional semantics* .......................... 1

**Dorothy Ahn**  
*Korean classifier-less number constructions* ............................................................. 23

**Sascha Alexeyenko**  
*Quantification in event semantics: Generalized quantifiers vs. sub-events* ............... 39

**Pranav Anand and Natasha Korotkova**  
*Acquaintance content and obviation* ................................................................. 55

**Pranav Anand and Maziar Toosaryandani**  
*No explanation for the historical present: Temporal sequencing and discourse* .......... 73

**Curt Anderson and Sebastian Löhner**  
*Roles and the compositional semantics of role-denoting relational adjectives* ......... 91

**Muriel Assmann, Daniel Büring, Izabela Jordanoska and Max Prüller**  
*Focus constraints on ellipsis — An unalternatives account* .................................. 109

**Corien Bary, Daniel Altshuler, Kristen Syrett and Peter De Swart**  
*Factors licensing embedded present tense in speech reports* ................................. 127

**Itai Bassi and Ezer Rasin**  
*Equational-intensional relative clauses with syntactic reconstruction* ....................... 143
<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrea Beltrama</td>
<td>Subjective assertions are weak: Exploring the illocutionary profile of perspective-dependent predicates</td>
<td>161</td>
</tr>
<tr>
<td>Andrea Beltrama, Erlinde Meertens and Maribel Romero</td>
<td>Decomposing cornering effects: an experimental study</td>
<td>175</td>
</tr>
<tr>
<td>Anton Benz, Carla Bombi and Nicole Gotzner</td>
<td>Scalar diversity and negative strengthening</td>
<td>191</td>
</tr>
<tr>
<td>Anton Benz, Nicole Gotzner and Lisa Raithel</td>
<td>Embedded implicature in a new interactive paradigm</td>
<td>205</td>
</tr>
<tr>
<td>M. Ryan Bochnak and Martina Martinovi[Please insert into preamble]</td>
<td>Modal height and modal flavor: The case of Wolof di</td>
<td>223</td>
</tr>
<tr>
<td>David Boylan</td>
<td>Miners and modals</td>
<td>241</td>
</tr>
<tr>
<td>Saskia Brockmann, Sara McConnell, Valentine Hacquard and Jeffrey Lidz</td>
<td>Children’s comprehension of pronouns and definites</td>
<td>259</td>
</tr>
<tr>
<td>Sebastian Bücking</td>
<td>Painting cows from a type-logical perspective</td>
<td>277</td>
</tr>
<tr>
<td>Nattanun Chanchaochai</td>
<td>On acquiring a complex personal reference system: Experimental results from Thai children with autism</td>
<td>295</td>
</tr>
<tr>
<td>WooJin Chung</td>
<td>Context updates in head-final languages: Linear order or hierarchy?</td>
<td>313</td>
</tr>
<tr>
<td>Ava Creemers, Jérémy Zehr and Florian Schwarz</td>
<td>Interpreting presuppositions in the scope of quantifiers: Every vs. at least one</td>
<td>331</td>
</tr>
<tr>
<td>Virginia Dawson</td>
<td>A new kind of epistemic indefinite</td>
<td>349</td>
</tr>
<tr>
<td>Michael Deigan</td>
<td>Counterfactual donkeys don’t get high</td>
<td>367</td>
</tr>
<tr>
<td>Maria Esipova</td>
<td>Focus on what’s not at issue: Gestures, presuppositions, appositives under contrastive focus</td>
<td>385</td>
</tr>
<tr>
<td>Danny Fox</td>
<td>Partition by exhaustification: Comments on Dayal 1996</td>
<td>403</td>
</tr>
<tr>
<td>Title</td>
<td>Authors</td>
<td></td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>The processing cost of Downward Entailingness: the representation and verification of comparative constructions</td>
<td>Yosef Grodzinsky, Galit Agmon, Kedem Snir, Isabelle Deschamps and Yonatan Loewenstein</td>
<td></td>
</tr>
<tr>
<td>Linguistic barriers to logical reasoning: a new perspective on Aristotelian syllogisms</td>
<td>Andreas Haida, Luka Crnič and Yosef Grodzinsky</td>
<td></td>
</tr>
<tr>
<td>A comparison of fei and aber</td>
<td>Stefan Hinterwimmer and Cornelia Ebert</td>
<td></td>
</tr>
<tr>
<td>QUD effects on epistemic containment principle: An experimental study</td>
<td>Sunwoo Jeong</td>
<td></td>
</tr>
<tr>
<td>Experimenting with imposters: What modulates choice of person agreement in pronouns?</td>
<td>Elsi Kaiser, Justin Nichols and Catherine Wang</td>
<td></td>
</tr>
<tr>
<td>Counteridenticals and dream reports: A unified analysis</td>
<td>Carina Kauf</td>
<td></td>
</tr>
<tr>
<td>A formal pragmatic account of Double Access</td>
<td>Peter Klecha</td>
<td></td>
</tr>
<tr>
<td>Hard cases of third readings in terms of the Standard Solution</td>
<td>Petr Kusliy and Ekaterina Vostrikova</td>
<td></td>
</tr>
<tr>
<td>Questioning speech acts</td>
<td>Jess H.-K. Law, Haoze Li and Diti Bhadra</td>
<td></td>
</tr>
<tr>
<td>Distinguishing coercion and underspecification in Type Composition Logic</td>
<td>Julia Lukassek and Alexandra Anna Spalek</td>
<td></td>
</tr>
<tr>
<td>Degrees as nominalized properties: Evidence from differential verbal comparatives in Mandarin Chinese</td>
<td>Qiongpeng Luo and Zhiguo Xie</td>
<td></td>
</tr>
<tr>
<td>Time in probabilistic causation: Direct vs. indirect uses of lexical causative verbs</td>
<td>Fabienne Martin</td>
<td></td>
</tr>
<tr>
<td>On competing degree morphemes in verbs of change in Southern Aymara</td>
<td>Gabriel Martínez Vera</td>
<td></td>
</tr>
<tr>
<td>Author(s)</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>-------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Melania S. Masià</td>
<td>Extreme nouns and maximizers</td>
<td>143</td>
</tr>
<tr>
<td>Jon Ander Mendia</td>
<td>Some kind of relative clause</td>
<td>163</td>
</tr>
<tr>
<td>Ralf Naumann, Wiebke Petersen and Thomas Gamerschlag</td>
<td>Underspecified changes: a dynamic, probabilistic frame theory for verbs</td>
<td>181</td>
</tr>
<tr>
<td>Pritty Patel-Grosz, Patrick Georg Grosz, Tejaswinee Kelkar and Alexander Refsum Jensenius</td>
<td>Coreference and disjoint reference in the semantics of narrative dance</td>
<td>199</td>
</tr>
<tr>
<td>Ethan Poole</td>
<td>Constraining (shifting) types at the interface</td>
<td>217</td>
</tr>
<tr>
<td>Claudia Poschmann</td>
<td>Embedding non-restrictive relative clauses</td>
<td>235</td>
</tr>
<tr>
<td>Claudia Poschmann, Sascha Bargmann, Christopher Götze, Anke Holler, Manfred Sailer, Gert Wehelhuth and Thomas Ede Zimmermann</td>
<td>Split-antecedent relative clauses and the symmetry of predicates</td>
<td>253</td>
</tr>
<tr>
<td>Tom Roberts</td>
<td>Responsive predicates are question-embedding: Evidence from Estonian</td>
<td>271</td>
</tr>
<tr>
<td>Vincent Rouillard and Bernhard Schwarz</td>
<td>Presuppositional implicatures: quantity or maximize presupposition?</td>
<td>289</td>
</tr>
<tr>
<td>Yağmur Sağ</td>
<td>The semantics of Turkish numeral constructions</td>
<td>307</td>
</tr>
<tr>
<td>Hiroaki Saito and Adrian Stegošec</td>
<td>The pa/wa of imperative alternatives</td>
<td>325</td>
</tr>
<tr>
<td>Katrin Schulz</td>
<td>The similarity approach strikes back: Negation in counterfactuals</td>
<td>343</td>
</tr>
<tr>
<td>Bernhard Schwarz and Alexandra Simonenko</td>
<td>Decomposing universal projection in questions</td>
<td>361</td>
</tr>
<tr>
<td>Radek Šimík</td>
<td>Ever free relatives crosslinguistically</td>
<td>375</td>
</tr>
<tr>
<td>Ryan Walter Smith and Ryoichiro Kobayashi</td>
<td>Alternating conj/disjunctions: the case of Japanese -toka and -tari</td>
<td>393</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Frank Sode</td>
<td>good as a predicate of worlds</td>
<td>407</td>
</tr>
<tr>
<td>Chao Sun and Richard Breheny</td>
<td>Shared mechanism underlying unembedded and embedded enrichments: Evidence from enrichment priming</td>
<td>425</td>
</tr>
<tr>
<td>Robert Van Rooij</td>
<td>Generics and typicality</td>
<td>443</td>
</tr>
<tr>
<td>Jérémy Zehr and Florian Schwarz</td>
<td>Returning to non-entailed presuppositions again</td>
<td>463</td>
</tr>
<tr>
<td>Linmin Zhang</td>
<td>Enough, too, and causal dependence</td>
<td>481</td>
</tr>
<tr>
<td>Sarah Zobel</td>
<td>An analysis of the semantic variability of weak adjuncts and its problems</td>
<td>499</td>
</tr>
</tbody>
</table>
Abstract. Counter to the often assumed division of labour between content and function words, we argue that both types of words have lexical content in addition to their logical content. We propose that the difference between the two types of words is a difference in degree. We conducted a preliminary study of quantificational determiners with methods from Distributional Semantics, a computational approach to natural language semantics. Our findings have implications both for distributional and formal semantics. For distributional semantics, they indicate a possible avenue that can be used to tap into the meaning of function words. For formal semantics, they bring into light the context-sensitive, lexical aspects of function words that can be recovered from the data even when these aspects are not overtly marked. Such pervasive context-sensitivity has profound implications for how we think about meaning in natural language.

Keywords: function words, lexical semantics, determiners, distributional semantics.

1. Introduction

Is there a categorical difference between the semantics of content (or open-class/lexical) words and function (or closed-class/logical) words in natural languages? Common wisdom in linguistic research holds that the answer is ‘yes’. According to this view, functional items encode the grammatical knowledge of language speakers, while content words are a reflex of world knowledge. In some incarnations of this view, the functional vocabulary is given by the language faculty, and is thus universal and biologically determined (see for example May 1991; Partee 1992; Chierchia 2013). It provides a syntactic skeleton into which lexical content is inserted, a mental coat rack onto which colourful content about the world can be hung.

Despite intuitions about the existence of the two classes, finding a precise semantic difference has proven to be difficult. The most frequently cited idea, borrowed from a tradition in logic aimed at defining logical constants, is that function words have meanings that are invariant across certain mathematical transformations of their domains. Examples of transformations that have been proposed to diagnose logical constants include invariance under permutations (Tarski and Givant 1987; van Benthem 1989; Sher 1991), invariance under surjective functions (Feferman 1999), invariance under potential isomorphisms (Bonnay 2008), etc. What all these have in common is the underlying idea that logical meanings are topic-independent: the validity

\begin{footnotesize}
\begin{enumerate}
\item We are grateful to the organisers of the Special Session on Semantics and Natural Logic for the invitation, the audience for helpful questions and an anonymous reviewer for copy-editing suggestions. The research reported here was supported by a Marie Curie FP7 Career Integration Grant, Grant Agreement Number PCIG13-GA-2013-618550, a grant overseen by the French National Research Agency ANR (ANR-14-CE24-0014), and by ERC grant number 269427.
\item Another idea that was advanced is that function words involve higher types than lexical items (cf. Partee 1992). See also MacFarlane (2017) for a review of the philosophical literature on logical constants.
\end{enumerate}
\end{footnotesize}
of a logical inference should not be dependent on the particular properties of what one is talking about. The appropriateness of the above ideas for diagnosing logical constants is a subject of lively debate, but they are clearly unsuitable for diagnosing function (logical) words of natural language (see Gajewski 2002; van Benthem 2002). This is because they predict certain lexical items to be logical (e.g. the predicates self-identical, exist), and they also predict that certain intuitively logical elements of natural language, e.g. the quantifier every or each, are not logical since they have a lexical restriction that they need to quantify over countable objects, hence *Every/*Each milk is in the fridge.

The intuitive distinction between the two classes of words seems at first to be supported by research in Distributional Semantics (DS). This computational approach to natural language semantics is based on the “distributional hypothesis” by Harris (1954), according to which one can infer a meaning of a word by looking at its context. Meanings of words differ in DS, because they will co-occur with different contexts with different probabilities. While the approach has been very successful in capturing the meanings of lexical words and lexical aspects of meaning in general (synonymy, hyponymy, etc.), there is very little evidence that DS can capture semantic properties of function words (though see Baroni et al. 2012; Bernardi et al. 2013; Hermann et al. 2013; Linzen et al. 2016). It is easy to see why: if logical meanings are topic-independent, their logical meanings will not be reflected by their distributions, and all logical words will have the same DS meaning.

However, the actual picture that emerges from DS is not a clear-cut division between the two classes of items. What we show in this paper is that when we approach function words (in particular, determiners) with DS methods, what comes to light is that logical items in natural language have a layer of non-logical meaning in addition to their logical meaning. Function words do not have purely logical content, but are a mixture of logical content and more “worldly” content comprised of lexical and distributional aspects of meaning. This is also one of the reasons why logical methods such as permutation invariance fail to diagnose functional items of natural language correctly. While DS is indeed blind to purely logical meaning, it brings to light the lexical and distributional aspects of functional items in natural language.

Our results suggest the following picture. There are context-invariant, logical aspects of meaning, and lexical/distributional aspects of meaning that tend to be modulated by the context. But the two types of meaning do not map neatly to two different types of words. More often than not, the total conceptual meaning of words is composed of both types of meaning, but to varying degrees. For example, an adjective such as heavy has, beside its lexical content relating to heaviness, a logical aspect of being a predicate over degrees. Aspects of the lexical meaning of heaviness can be modulated by context (heavy elephant vs. heavy bleeding), but not the logical meaning of being a degree predicate. A determiner such as some has, besides its logical meaning of being an existential quantifier, context-sensitive lexical aspects, for example an inference of uncertainty about identity on the part of the speaker. This type of lexical content of quantifiers has a high degree of contextual variability, similarly to other types of lexical content (e.g. Some guy called you vs. There is some milk in the fridge).
Our results connect to a growing body of evidence that challenges the traditional division between lexical and functional words. Firstly, one of the reasons why permutation invariance fails to correctly capture logical words in natural language is because of the sensitivity of these items to the properties of the linguistic and extralinguistic context. Sensitivity of certain quantifiers to the mass/count distinction, indefinites introducing discourse referents, the focus sensitivity of particles and negation, etc. are all examples of such lexical (or pragmatic) dependencies of the context. Such context-sensitivity is the essence of non-logical content.

A second, theoretical argument might come from language variation. The quantifier systems of even very closely related languages can be quite different. However, the variation, at least in the case of well-studied European languages, is not so much in the logical content expressed but more in the non-logical content associated with quantifiers. For example, indefinites in English (\textit{a}, \textit{some}, \textit{any}) and German (\textit{ein}, \textit{irgendein}, \textit{etwas}, etc.) differ not in their logical meanings but in the non-logical, lexical and distributional aspects associated with them.

A third reason for challenging the idea of a clean cut between the two types of words might come from historical linguistics: recent advances in this field seem to call into question the traditional idea according to which functional items are more stable than lexical items. For example, Greenhill et al. (2017) argue that grammatical features tend to change faster than basic lexical vocabulary. Similarly, a substantial part of the functional vocabulary belongs to the fast-changing items in the lexicon. This shows that functional items and grammatical features are not, generally speaking, the stable pillars in the dynamics of language change that they were often assumed to be. Various subsystems of language show differing patterns of dynamics, but the classification into these subsystems does not follow the lexical/functional division.

What our results add to the above theoretical arguments is that they bring to light the lexical and distributional aspects of the meaning of quantifiers, even when these are not overtly marked by the morphology. Our methods, based on distributional semantics, can associate latent semantic dimensions to these quantifiers. Some of these correspond to well-known aspects of quantifiers with a special distribution (e.g. \textit{any}), and some correspond to semantic distinctions that are unmarked in English but marked in other languages, as in the case of \textit{some}.

Our view of lexical semantics is a mixed model that incorporates elements from both traditional approaches to lexical semantics and distributional semantics. Traditionally, the lexical semantics of a word is the meaning that is associated with it in the lexicon. This meaning is assumed to depend on the circumstances of the evaluation (or contexts in the sense of Kaplan 1989) in the case of many lexical items, for example indexicals, demonstratives and possibly a large number of other items such as adjectives, attitude verbs, etc. Context-sensitivity, in these systems, means that the lexical meaning contains a variable whose value needs to be fixed by some context. For example, the cutoff-point for a degree adjective such as \textit{heavy} might be supplied by the context and will be different for elephants and for mice. The lexical meaning offered by distributional semantics is context-sensitive in a much more radical way: the conceptual structures that we associate with words are gleaned from the contexts of use (dis-

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3We advance this argument tentatively, since none of the authors is an expert in historical linguistics. Greenhill et al.’s (2017) article seems highly pertinent though, which is why we mention it here.
tributions) and might change with use over time and across different corpora. In the mixed model we assume here (see Asher et al. 2016) words have logical content (which we cannot derive from distributions, for the reasons described above) which plays a role not only in establishing their denotation but also in the composition of meaning as well; the logical content of an adjective, for instance, is that it must modify in some way a noun meaning, and all adjectives have that function, though their modification may proceed in different ways depending on whether they are subsective or non-subsective. However, all words also have lexical and distributional aspects which we can induce from our corpora via DS methods. These include what is traditionally thought of as the conceptual content associated with words (e.g. whatever makes an elephant an elephant) and also distributional (selectional) restrictions. While logical content is by nature context-invariant, lexical content is by nature context-sensitive in the sense that underspecified (‘clouds of’) meanings get precisified, shifted and modulated in context as in the case of heavy bleeding vs. heavy box. Our mixed model assumes that the two types of content complement and interact with each other.

Recognising the important aspect that the lexical (and pragmatic) aspects of function words play in their meaning also delineates which avenues are open for distributional semantics when it comes to approaching logical meanings. Lexical aspects of function words open a sideway by which it might be possible to approach the meaning of function words in natural language indirectly. One example of such an approach is Kruszewski et al.’s (2016) article, which proposes to tap into the meaning of negation in natural language by exploiting its focus-sensitive nature.

Our view also has consequences for the idea of the ‘Logicality of language’, proposed recently by Gajewski (2002), Fox and Hackl (2007) and Chierchia (2013), among others. These approaches rely crucially on the idea that there is a fundamental distinction between content and function words in natural language and that grammar is sensitive only to the content of functional vocabulary. If our approach is on the right track, then the presupposition of these accounts is not met in natural languages: the two types of content do not map to two different types of vocabulary. In Abrusán et al. (to appear) we spell out an alternative approach to explain the problems discussed in the ‘Logicality of language’ tradition that does not need this distinction.

In what follows, we first provide a brief introduction to the DS methods we used in Asher et al. (2016) and outline how these methods can inform us about meaning shifts. In Section 3 we show, based on preliminary results, what these methods give us when applied to determiner-noun combinations. In Section 4 we offer some speculations about what these findings imply for formal semantics.

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4 Although there is a conjunction in the expression ‘lexical and distributional’, in fact these are the same type of meaning from the point of view of DS.
2. Distributional Semantics and meaning shifts

Distributional Semantics, a computational approach to natural language semantics, can throw new light on meaning shifts in co-composition, as was shown in Asher et al. (2016). This paper outlines a close correspondence between Asher’s (2011) Type Composition Logic (TCL) and DS methods that we will describe below. Below we provide a brief description of some of the distributional methods we used in this work. For details concerning how to translate the results of the distributional study into a symbolic system, readers are invited to consult Asher et al. (2016).

2.1. Distributional Semantics

Distributional Semantics is based on the so called “distributional hypothesis” by Harris (1954), according to which one can infer a meaning of a word by looking at its context. Observe the following examples for illustration:

(1) a. tasty sooluceps
    b. sweet sooluceps
    c. stale sooluceps
    d. freshly baked sooluceps

The reader, even though they have never heard the word sooluceps before, is able to infer from the above examples that it is some sort of food, perhaps a type of cookie. How is this possible? It must be that the adjectives that modify this noun provide a clue as to the meaning of the noun.

In distributional semantics this idea is generalised as follows. The co-occurrence frequencies of two entities are captured by word vectors. Observe first the following toy example in which the co-occurrence frequencies of 4 nouns with 4 adjectives in some corpus are given:

<table>
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<th></th>
<th>red</th>
<th>tasty</th>
<th>fast</th>
<th>second-hand</th>
</tr>
</thead>
<tbody>
<tr>
<td>raspberry</td>
<td>728</td>
<td>592</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>strawberry</td>
<td>1035</td>
<td>437</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>car</td>
<td>392</td>
<td>0</td>
<td>487</td>
<td>370</td>
</tr>
<tr>
<td>truck</td>
<td>104</td>
<td>0</td>
<td>393</td>
<td>293</td>
</tr>
</tbody>
</table>

Table 1: A toy example

One way of thinking about word meaning within Distributional Semantics is to assume that it is a vector in some space \( V \) whose dimensions are contextual features. So in the above toy example, the meaning of raspberry is given by the vector that captures its co-occurrence frequencies with the adjectives red, tasty, fast, second-hand. A graphical representation of such vectors in two-dimensional space (since four-dimensional spaces are hard to draw) is presented in Figure 1, with the two dimensions being fast and red.
Figure 1: A graphical representation of word vectors in two-dimensional space

The graphical representation suggests a certain intuitive similarity between the words strawberry and raspberry as opposed to car: the vectors of the former two words have similar direction in vector space. This similarity can be captured mathematically by measuring the cosine similarity of the two vectors.\(^5\)

2.2. Dimension reduction and aspects of meaning

When we move from toy examples towards real data, words × context matrices become very large and very sparse, with thousands if not hundreds of thousands of rows and columns. Contexts can include words and/or grammatical features or dependency relations that appear within a window of any size, where the window might be the sentence that the word appears in, or simply a certain number of words preceding and following a word, or something else still. In order to bring out the ‘information content’ in such huge matrices, dimensionality reduction techniques are applied. A dimensionality reduction reduces the abundance of overlapping contextual features to a limited number of meaningful, latent semantic dimensions.

**Singular value decomposition** While rooted in linear algebra, singular value decomposition (SVD) has proven to be a useful tool in statistical applications. It is closely related to statistical methods such as principal components analysis and factor analysis. SVD stems from a well known theorem in linear algebra: a rectangular matrix can be decomposed into three other matrices of specific forms, so that the product of these three matrices is equal to the original matrix:

\[
A_{m \times n} = U_{m \times z} \Sigma_{z \times z} (V_{n \times z})^T
\]  

where \( z = \min(m, n) \). Matrix \( A \) is the original matrix of size \( m \times n \). Matrix \( U \) is an \( m \times z \) matrix that contains newly derived vectors called left-singular vectors. Matrix \( V^T \) denotes the transpose of matrix \( V \), an \( n \times z \) matrix of derived vectors called right-singular vectors. The third matrix \( \Sigma \) is a \( z \times z \) square diagonal matrix (i.e. a square matrix with non-zero entries only

\(^5\)Cosine similarity is just one of the various similarity measures that can be used, though probably the most popular (Turney and Pantel, 2010).
along the diagonal); \( \Sigma \) contains derived constants called singular values. A key property of the derived vectors is that all dimensions are orthogonal (i.e., linearly independent) to each other, so that each dimension is uncorrelated to the others.

The diagonal matrix \( \Sigma \) contains the singular values in descending order. Each singular value represents the amount of variance that is captured by a particular dimension. The left-singular and right-singular vector linked to the highest singular value represent the most important dimension in the data (i.e., the dimension that explains the most variance of the matrix); the singular vectors linked to the second highest value represent the second most important dimension (orthogonal to the first one), and so on. Typically, one uses only the first \( k \ll z \) dimensions, stripping off the remaining singular values and singular vectors.\(^6\) If one or more of the least significant singular values are omitted, then the reconstructed matrix will be the best possible least-squares approximation of the original matrix in the lower dimensional space. Intuitively, SVD is able to transform the original matrix—with an abundance of overlapping dimensions—into a new matrix that is many times smaller and able to describe the data in terms of its principal components. Due to this dimension reduction, a more succinct and more general representation of the data is obtained. Redundancy is filtered out, and data sparseness is reduced.

SVD is the underlying technique of the well-known information retrieval and text analysis method called Latent Semantic Analysis (Landauer and Dumais 1997; Landauer et al. 1998). A key characteristic of the resulting decomposition is that it contains both positive and negative values. Though the decomposition contains usable latent dimensions, it turns out the negative values make the resulting dimensions difficult to interpret. The application of a non-negative constraint, as in the factorization technique described in the following section, remediates this shortcoming.

**Non-negative matrix factorization** Another dimensionality reduction technique we deem particularly useful for semantic analysis is non-negative matrix factorisation (NMF; Lee and Seung, 1999). There are a number of reasons to prefer NMF over the better known singular value decomposition used in LSA. First of all, NMF allows us to minimize the Kullback-Leibler divergence as an objective function, whereas SVD minimizes the Euclidean distance. The Kullback-Leibler divergence is better suited for language phenomena. Minimizing the Euclidean distance requires normally distributed data, and language phenomena are typically not normally distributed (Baayen 2001). Secondly, the non-negative nature of the factorization ensures that only additive and no subtractive relations are allowed. This proves particularly useful for the extraction of semantic dimensions, so that the NMF model is able to extract much more clear-cut dimensions than an SVD model. And thirdly, the non-negative property allows the resulting model to be interpreted probabilistically, which is not straightforward with an SVD factorization.

Given a non-negative matrix \( V \), NMF finds non-negative matrix factors \( W \) and \( H \) such that when multiplied, they approximately reconstruct \( V \):

\(^6\)A typical choice for \( k \) would be 300.
\[ \mathbf{V}_{n \times m} \approx \mathbf{W}_{n \times k} \mathbf{H}_{k \times m} \]  

(2)

A graphical representation of NMF applied to a matrix of nouns by context words is given in Figure 2.

![Graphical representation of NMF](image)

Figure 2: A graphical representation of NMF

As its name indicates, this factorization observes the constraint that all values in the three matrices need to be non-negative \((\geq 0)\). Choosing \(k \ll n, m\) reduces data significantly; for word-context matrices, \(k\) is typically chosen within the range 100–600.

As it turns out, reducing word-context matrices using NMF is particularly useful for finding topical, thematic information. For many of the \(k\) dimensions, the words with the highest value on that dimension seem to belong to the same topical field. Observe for example the nouns with the highest values on a number of example dimensions in Table 2 (computed from a word-context matrix extracted from Wikipedia). The examples indicate that NMF is able to automatically induce topically salient dimensions: dimension 60 has something to do with transport, dimension 88 with publishing, dimension 89 with computing and dimension 120 with living spaces. Although the labels of these dimensions are not given automatically, it is intuitive to think of these dimensions as semantic features, or topics. Factorisation also allows a more abstract way of representing the meaning of a word: we can now say that the meaning of a word is represented by a vector of size \(k\) whose dimensions are latent features.

<table>
<thead>
<tr>
<th>\textbf{dim 60}</th>
<th>\textbf{dim 88}</th>
<th>\textbf{dim 89}</th>
<th>\textbf{dim 120}</th>
</tr>
</thead>
<tbody>
<tr>
<td>rail</td>
<td>journal</td>
<td>filename</td>
<td>bathroom</td>
</tr>
<tr>
<td>bus</td>
<td>book</td>
<td>null</td>
<td>lounge</td>
</tr>
<tr>
<td>ferry</td>
<td>preface</td>
<td>integer</td>
<td>bedroom</td>
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<tr>
<td>train</td>
<td>anthology</td>
<td>string</td>
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<td>freight</td>
<td>author</td>
<td>parameter</td>
<td>WC</td>
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<tr>
<td>commuter</td>
<td>monograph</td>
<td>String</td>
<td>ensuite</td>
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<td>tram</td>
<td>article</td>
<td>char</td>
<td>fireplace</td>
</tr>
<tr>
<td>airport</td>
<td>magazine</td>
<td>boolean</td>
<td>room</td>
</tr>
<tr>
<td>Heathrow</td>
<td>publisher</td>
<td>default</td>
<td>patio</td>
</tr>
<tr>
<td>Gatwick</td>
<td>pamphlet</td>
<td>int</td>
<td>dining</td>
</tr>
</tbody>
</table>

Table 2: Example dimensions \((k=300)\)
Word embeddings  Thirdly, we want to briefly touch upon a dimensionality reduction technique known as word embeddings. Though word embeddings are related to the factorization techniques mentioned above, the methods used to induce them operate somewhat differently. Word embeddings became popular with the recent surge of neural network methods for natural language processing applications (Collobert et al., 2011). By word embeddings, one usually denotes the low-level vector representations that serve as input to neural networks; the vector representations are typically automatically induced as parameters within the neural network, training on a particular task at hand. Word embeddings are often pre-trained in an unsupervised fashion by means of context prediction (Mikolov et al., 2013). As such, they are another instantiation of the distributional hypothesis.

As with SVD, word embeddings contain negative values, and therefore are more cumbersome when interpretation is concerned. Moreover, there is research that establishes a connection between SVD and induction methods for word embeddings (Levy and Goldberg, 2014). Still, there is a strong consensus within the NLP community that word embeddings provide adequate semantic representations, and as a result they might be useful for research on logical aspects of lexical items. We have not explored word embeddings in our research so far, but leave this interesting avenue for future work.

2.3. Composition: from aspects to meaning shifts

We have seen above how DS can generate vectors to capture individual word meaning and bring out latent dimensions that might correspond to semantic features. But what sort of semantic features would they be? In a purely denotational theory of meaning in which an expression would denote some sort of an intension, it is unclear how to represent these latent dimensions or indeed the collection of them as represented in a DS vector. In Asher et al. (2016), we took the view that DS vectors correspond to internal meanings or types, which the composition system uses to construct logical forms. Asher (2011), for instance, uses types to predict semantic anomalies and shifts in the meanings of polysemous words and already makes use of aspects in types, which we can think of as latent dimensions.

But how do we know that these latent dimensions could correspond to semantic features? One way to see this is to examine what happens in composition. If these latent dimensions affect composition and make empirically testable predictions about the semantic values of composing expressions, then that is evidence that these dimensions do correspond to semantic features. DS methods of composition involve the manipulation of vectorial or other algebraic representations of lexical content using various mathematical operations: vector addition, vector multiplication, and more complex forms of combination such as we will see below. The view from the DS approach connects to a growing body of work that assumes that the meaning of lexical words can be shifted or modulated in one way or another: either within the semantics (cf. e.g. Martí 2006; Stanley 2007; Asher 2011; Alxatib and Sauerland 2013) or within the pragmatics (Kamp and Partee 1995; Recanati 2010; Lasersohn 2012). Since we assume that meaning shift diagnosed by DS approaches happens at the compositional level, the view from DS is more in line with semantic approaches.
We have developed models of composition that show how the content of each word is modified during composition. Formally, our method is a DS implementation of the symbolic approach in Asher (2011). Asher’s TCL approach provides the basic logical meanings for all expressions, including for instance their basic type information and methods of composition. In addition, it assumes a rich set of subtypes of the type of entities, and this assumption drives TCL’s account of meaning shift in coercions and aspect selection in dual aspect nouns (Cruse 1986). However, like other symbolic methods, TCL has little to say about the content of the type associated with those subtypes. DS methods on the other hand tell us what the contents of those types are and how the compositional process modifies those contents. This method, applied for instance to the composition of an adjective with the noun it modifies, looks like this, where \( A \) is the adjective and \( N \) is the noun:

\[
AN: \lambda x (O_A(N(x)) \land M_N(A(x)))
\]

\( O \) and \( M \) are functors intended to capture the shift in meaning induced by the compositional process. For an an expression like heavy traffic we would have:

\[
\text{heavy traffic} : \lambda x. (O(\text{heavy})(x) \land M(\text{traffic})(x))
\]

The meaning of both nouns and adjectives can thus change in this system, according to the words they combine with. However, Asher (2011) does not supply a method for constructing the functors \( O \) and \( M \). This is what we can do with DS automatically. Moreover, as we will see below in our discussion of a previous study on nouns and adjectives, different latent dimensions of meaning of both the adjective and the noun can be reinforced, depending on what these expressions combine with.

2.4. A distributional model for compositionality

In order to capture meaning shift as in the case of heavy traffic, the meaning of the adjective needs to be adapted to the context of the particular noun that it co-occurs with. That is, the distributional model needs to provide us with the functors \( O_A \) and \( M_N \) in the TCL approach. In Asher et al. (2016), we chose two different approaches that meet this requirement: one based on matrix factorization (Van de Cruys et al., 2011) and one based on tensor factorization (Van de Cruys et al., 2013). In what follows, we describe briefly the second method and the results we got with it. Note that the following paragraphs only provide a brief overview of the model; for more details, see Asher et al. (2016).

**Tensor factorization** The approach based on tensor factorization allows for a rich and flexible modeling of the interaction between adjectives and nouns, in order to provide an adequate representation of each when they appear in each other’s context. The key idea is to factorize a three-way tensor\(^7\) that contains the multi-way co-occurrences of nouns, adjectives and other dependency relations (in a direct dependency relationship to the noun) that appear together at

---

\(^7\)A tensor is the generalization of a matrix to more than two axes or modes.
the same time. A number of well-known tensor factorization algorithms exist; we opted for an algorithm called Tucker factorization, which allows for a richer modeling of multi-way interactions using a core tensor. In Tucker factorization, a tensor is decomposed into a core tensor, multiplied by a matrix along each mode. For a three-mode tensor \( X \in \mathbb{R}^{I \times J \times L} \), the model is defined as follows:

\[
X = G \times_1 A \times_2 B \times_3 C
\]

where \( \times \) represents the outer product of vectors. By setting \( P, Q, R \ll I, J, L \), the factorization represents a compressed, latent version of the original tensor \( X \); matrices \( A \in \mathbb{R}^{I \times P} \), \( B \in \mathbb{R}^{J \times Q} \), and \( C \in \mathbb{R}^{L \times R} \) represent the latent factors for each mode, while \( G \in \mathbb{R}^{P \times Q \times R} \) indicates the level of interaction between the different latent factors. Figure 3 shows a graphical representation of Tucker decomposition.  

![Figure 3: A graphical representation of Tucker decomposition](image)

We carried out the factorization with non-negative constraints, and we found the best possible fit to the original tensor \( X \) using Kullback-Leibler divergence, a standard information-theoretic measure. To ensure that the algorithm for non-negative Tucker decomposition finds a good global optimum, we initialized the three matrices using data that comes from non-negative matrix factorization, cf. Asher et al. (2016).

**Computing meaning shifts** We can now compute a representation for a particular adjective-noun composition. In order to do so, we first extract the vectors for the noun \( a_i \) and adjective \( b_j \) from the corresponding matrices \( A \) and \( B \). We multiply those vectors into the core tensor, in

\[X = \sum_{p=1}^{P} \sum_{q=1}^{Q} \sum_{r=1}^{R} g_{pqr} a_p \circ b_q \circ c_r\]

where \( \circ \) represents the outer product of vectors. By setting \( P, Q, R \ll I, J, L \), the factorization represents a compressed, latent version of the original tensor \( X \); matrices \( A \in \mathbb{R}^{I \times P} \), \( B \in \mathbb{R}^{J \times Q} \), and \( C \in \mathbb{R}^{L \times R} \) represent the latent factors for each mode, while \( G \in \mathbb{R}^{P \times Q \times R} \) indicates the level of interaction between the different latent factors. Figure 3 shows a graphical representation of Tucker decomposition.  

Where \( P = Q = R = K \), i.e. the same number of latent factors \( K \) is used for each mode.
order to get a vector $h$ representing the importance of latent dimensions given the composition of noun $i$ and adjective $j$, i.e.

$$h = G \times_1 a^i \times_2 b^j$$  \hspace{1cm} (4)

By multiplying the vector representing the latent dimension with the transpose of the matrix for the mode with dependency relations ($C^T$), we are able to compute a vector $d$ representing the importance of each dependency feature given the adjective-noun composition, i.e.

$$d = hC^T$$  \hspace{1cm} (5)

The vector $d$ is in effect the DS version of TCL’s functor $O_A$, which we now have to combine with the original noun meaning. This last step goes as follows in DS: we weight the original noun vector according to the importance of each dependency feature given the adjective-noun composition, by taking the point-wise multiplication of vector $d$ and the original noun vector $v$, i.e.

$$v'_d = d \cdot v_d$$  \hspace{1cm} (6)

Note that we could just keep the representation of our adjective-noun composition in latent space. In practice, the original dependency-based representation provides a much richer semantics, which is why we have chosen to perform an extra step weighting the original vector.

**Some implementational details** We used the UKWaC corpus (Baroni et al., 2009), an internet corpus of about 1.5 billion words, to construct the algebraic structures for our approaches. We tagged the corpus with part-of-speech tags, lemmatized it with Stanford Part-Of-Speech Tagger (Toutanova and Manning, 2000; Toutanova et al., 2003), and parsed it using MaltParser (Nivre et al., 2006). We extracted our input tensor $X$ of 5000 nouns by 2000 adjectives by 80,000 dependency relations from the corpus. The tensor $X$ was weighted using a three-way extension of PMI (Van de Cruys, 2011). We set $K = 300$ as our number of latent factors. All similarity computations were performed using cosine as a similarity measure.

**An example** Finally, observe an example illustrating the unshifted meaning of the adjective *heavy* vs. the shifted meaning of the same adjective in the context of the noun *traffic*:

(4) **heavy$_A$**: heavy$_A$ (.000), torrential$_A$ (.149), light$_A$ (.140), thick$_A$ (.127), massive$_A$ (.118), excessive$_A$ (.115), soft$_A$ (.107), large$_A$ (.107), huge$_A$ (.104), big$_A$ (.103)

(5) **heavy$_A$**, traffic$_N$: heavy$_A$ (.293), motorised$_A$ (.231), vehicular$_A$ (.229), peak$_A$ (.181), one-way$_A$ (.181), horse-drawn$_A$ (.175), fast-moving$_A$ (.164), articulated$_A$ (.158), calming$_A$ (.156), horrendous$_A$ (.146)
There is an evident shift in the composed meaning of heavy relative to its original meaning; there is no overlap in the lists (4) and (5) above except for heavy. We see this also in the quantitative measure of cosine similarity, \( \text{sim}_{\cos} \), between the original vector for heavy \( \vec{v}_0 \) and the modified vector for heavy \( \vec{v}_1 \) as modified by its predicational context: With the tensor model, on average, \( \text{sim}_{\cos}(\vec{v}_{\text{orig}}, \vec{v}_{\text{mod}}) \) was 0.2 for adjectives and 0.5 for nouns. In addition, these different senses of heavy were reflected in the dimensions in which heavy occurred, thus confirming that aspects of meaning affect composition and meaning shift. Finally, Asher et al. (2016) validated these meaning shifts in terms of speaker judgments.

3. Determiners, logical meaning and shiftable meaning

We have seen above how distributional semantics can inform us about the nature of meaning shifts. The distributional method that we introduced above for calculating meaning shift adapts the vector of the original predicate to its predicational context using the latent dimensions derived during dimensionality reduction. The way the distributional method calculates meaning shifts implies that meaning shift crucially depends on the latent dimensions that we find during tensor factorisation: it is the semantic features implicitly present in the latent dimension that drive the meaning shift. Distributional semantics thus picks up the aspects of lexical meaning that vary with the context: these are the aspects of the meaning that are affected by changes in the distribution. As a result, DS can tell us about which aspects of meaning of an expression can shift; aspects of the meaning that correspond to (or interact with) semantic dimensions uncovered by distributional semantics methods are in principle shiftable. In contrast, aspects of the meaning that are invisible for DS are unshiftable. In Abrusán et al. (to appear), we argue that clashes in unshiftable content of a predicate and its argument lead to semantic anomaly, and shiftable contents lead to shifts of meaning in composition.

We now apply a distributional approach to determiners. Do determiners have meanings that can shift, or do they have only unshiftable meanings? Logical meaning, the meaning upon which valid inferences rest, must be present in all contexts, and so we expect it to be invisible for DS; in particular, we expect that it will not show up in dimensions of the latent space where certain contexts are operative. So, whether or not we get logical meaning or any other meaning to shift depends on whether we find latent dimensions with our dimensionality reduction methods that correspond to logical meaning.

In recent work we performed a number of preliminary experiments similar to the ones described in the previous section but this time with determiner-noun compositions. Specifically, we looked at four determiners, \( a, \text{any}, \text{some} \) and \( \text{every} \) using two different corpora: Wikipedia, and a corpus of unpublished novels collected from the web (Zhu et al., 2015).\(^9\) We extracted an input tensor \( X \) of 5000 nouns by four determiners by 80,000 dependency relations from each of the two corpora. The tensors were weighted using a three-way extension of PMI, cf. Van de Cruys (2011). The tensor was factorized using tensor factorization, with \( k = 30 \) as our number of latent factors.

\(^9\)The former corpus contains about 1 billion words, the latter about 1.5 billion words. Preprocessing was performed similarly to the approach described in Section 2.4.
In the resulting factorization, determiners and nouns as well as dependency relations are all linked to the same latent dimension. We can now go and inspect each of the 30 latent dimensions manually, by looking at the list of highest ranked words in each dimension. In the corpus of novels, we found that out of the 30 dimensions, 5 had *some* as the most important determiner (i.e. the determiner with the highest value), 3 dimensions had *every* as the most important determiner, and in 1 dimension *any* was the most important. The remaining dimensions were dominated by the determiner *a*. We found similar results with the Wikipedia corpus: we found 3 dimensions with *some* being highly ranked, 3 dimensions with *any* being highly ranked and one dimension with *every* highly ranked. The rest of the dimensions were dimensions with the determiner *a* ranked most highly. In the following paragraphs, we try to identify a number of semantic characterizations linked to the latent dimensions.

**Dimensions**  
An intuitive evaluation of the semantic coherence of each of the 30 dimensions was conducted by the authors, and we have found that many of these seem to capture interesting semantic features, albeit not logical features. Here we describe the results of the Novels corpus.\(^{10}\) In the case of the determiner *some*, we found that two of the 5 dimensions seem to capture uncertainty or indifference about the identity of the discourse referent in question. We see this from trying to recompose the highest ranked determiner with the highest ranked nouns and other dependency features on a particular dimension, cf. examples in (6). Another two of the five dimensions capture measure or quantity readings with *some*, the difference between the two dimensions being that in one we found nouns that denote more concrete things (e.g. food), in the other we find more abstract nouns. The fifth dimension arguably captures kind or sort readings with *some*.

(6) *some*  
\begin{enumerate}
  \item [uncertainty, indifference]: e.g. some people argue; for some reason; on some level  
  \item [measure/quantity]: e.g. some food, some protection, some comfort, some help  
  \item [kind/sort]: e.g. some kind, some sort
\end{enumerate}

With the determiner *every*, one dimension we got very robustly was a temporal dimension: the highest ranked nouns were all temporal. Another dimension seemed to capture part-whole relations, see (7b). (We could not make sense of the third dimension, which is why we omitted it here.)

(7) *every*  
\begin{enumerate}
  \item [temporal]: e.g. every day, every year, every minute  
  \item [part-whole]: e.g. every inch, every detail, every part
\end{enumerate}

The dimension we got with the determiner *any* seems to correspond to the negative polarity (possibly also free choice?), with negation and the modals *could* and *would* being the highest ranked modifiers among dependency features.

\(^{10}\)The results of the study on the Wikipedia corpus were similar, but less rich.
any
[negative polarity]: e.g. not show any emotion, without any warning, at any moment

In the case of the determiner *a*, we mostly found topical dimensions, e.g. legal, publishing, building construction, political campaigns, people, etc. (especially in the Wikipedia corpus). In some dimensions *a* appeared exclusively within prepositional modifier phrases (*in a chair, with a grin*). The rest of the dimensions were uninterpretable to us. We must hence be careful about making too many claims about these dimensions of determiner meaning. However, we hope to demonstrate in future work that these dimensions recur in different corpora and when choosing different latent spaces. If this is the case, then we think this is good evidence that these semantic principles are part of the determiners’ internal meanings.

**Interpretation**  What we have described above is still work in progress, but it is already clear that we are not getting any dimensions via tensor factorisation that correspond to logical meaning. As a consequence, we are not going to get logical meaning to shift. This is not surprising given that logical meanings are supposed to validate logical deductions universally regardless of context. Thus the fact that logical meaning shouldn’t shift with content comes with the definition of logical meaning and the universally valid inferences it purports to underwrite.

On the other hand, it seems to us that the dimensions that we do get correspond to some aspects of the *lexical/distributional* meaning of quantifiers. In light of this, one way to interpret our results with the determiner *a* is that this determiner does not have any extra conceptual content beyond its logical meaning. In the case of *any* we get a dimension that captures its peculiar distribution. Most interestingly, perhaps, the dimensions we find with the quantifier *some* correspond to non-logical aspects of its use that have puzzled semanticists for a long time. The first of these is uncertainty about identity (also known as the *epistemic* aspect of indefinites). Indefinites with an epistemic effect can be marked by a special determiner in many languages, e.g. in German or Spanish (cf. Kratzer and Shimoyama 2002; Alonso-Ovalle and Menéndez-Benito 2015). Other aspects of the determiner *some* include measure and kind readings. In some languages, all these different aspects are marked explicitly, e.g. in Hungarian and in many Slavic languages (cf. Haspelmath 1997; Szabolcsi 2015). In particular, the Hungarian determiner *some* incorporates *wh*-words and the relevant aspects of *some* are tied to the *wh*-word:

(9) Indefinite determiners in Hungarian: VALA+WH-word N:
   a. vala+mi N [lit: some+what\(N\)]:
      suggests uncertainty about the identity of N, e.g. some guy
   b. vala+milyen N [lit: some+what\(A\)]:
      kind or sortal reading: e.g. some kind of drug
   c. vala+melyik N [lit: some+which]:
      partitive reading: one of the Ns
   d. vala+mennyi N [lit: some+how-much]:
      amount reading: some amount of N
   e. vala+hany N [lit: some+how-many]:
      count reading: some number of N
Note that *vala-* in itself is not a word and so every occurrence of the determiner *some* incorporates a wh-word. As a result, *some* in Hungarian is always classified into one of the readings signaled by the wh-word.\(^\text{11}\) Below are some typical examples found on the web:

(10)  

a. A bárban *valami pasas* énekelte Woody Guthrie számokat.  
   ‘In the bar *some guy* was singing Woody Guthrie songs.’

b. Próbált emlékezni, de nem ment. Mintha leblokkolt volna az agya, mintha *valamilyen gyógyszer* hatása alatt állt volna.  
   ‘He was trying to remember, but couldn’t. As if his brain had gone blank, as if he was under the effect of *some drug.*’

c. De mi van olyankor, ha *valamelyik családtag* allergiás?  
   ‘But what happens if *some family member* has allergy?’

d. A szeretetben mindig van *valamennyi Őrület*. De az Őrületben is mindig van *valamennyi ész*. (F. Nietzsche)\(^\text{12}\)  
   ‘In love there is always *some madness*. But there is also *some reason* in madness.’

e. Volt *valahány gyerek* a kertben.  
   ‘There were some children in the garden (I do not know how many).’

Finally, the dimensions we find with the quantifier *every* are somewhat puzzling and not easy to interpret. Probably, the part-whole distinction corresponds to a semantically relevant dimension, since universals (and also existentials) often appear with overt partitive constructions. In contrast, the temporal dimension we found might simply be an artifact of the extremely frequent use of *every* with temporal nouns in context.\(^\text{13}\)

4. What does this mean for linguistics?

In the previous section, we showed that determiners, like open class nouns and adjectives, have aspects of meaning that cluster in some but not all latent dimensions. Given our experiments on adjective noun composition, we fully expect that composition of a determiner with a common noun phrase (NP) to form a DP will also exhibit shifts in meaning—not shifts in logical meaning (*every* doesn’t suddenly mean *some* or *many*) but shifts in the sort of meanings we have found in the latent dimensions like epistemic indefinites, the negative polarity semantic behavior of *any* and less well known aspects like the dimension of *every* that selects for temporal NPs. In this section, we speculate how our observations relate to semantics as more traditionally construed.

4.1. Different corpora: different meaning aspects?

In our studies we looked at two different corpora to provide us with contexts and finally a set of latent dimensions for our determiners. We also examined spaces with different numbers of latent dimensions. Happily, the aspects of determiner meaning that we reported on above

\(^{11}\)We find the same pattern in Hungarian with free choice items and also negative existentials: *akármilyen, akármélyik, akármi,* etc.

\(^{12}\)‘Es ist immer etwas Wahnsinn in der Liebe. Es ist aber immer auch etwas Vernunft im Wahnsinn.’ - Thus Spoke Zarathustra (1885)

\(^{13}\)To see if this is indeed the case, it would be interesting to compare *every* with *each* and *all.*
showed up across all the latent spaces. Moreover, at least some of the aspects we isolated are grammatically marked in languages other than English, and that in itself is evidence that they correspond to aspects of the semantics of the expressions. On the other hand, it is clear that the analysis of dimensions or the shifts in meaning that these dimensions induce in composition do not exhaust the meaning of expressions. No distributional semanticist, we believe, would conclude that, just because we don’t see the logical meaning of *every* showing up in any particular dimension, it does not have the logical meaning that it evidently does. But then how do or should these different aspects of determiner meaning relate to the core logical meaning? In our DS model and the underlying theory of types that it implements, we suppose that since logical meaning is present in every context of use, and hence in every latent dimension, the operations we do to bring out certain aspects of meaning that are more present in some contexts will not affect the logical meaning of the determiner. The logical meaning is a constant component of the type, while the shiftable aspects of meaning are more or less present depending on what the determiner is composing with.

This view of composition already indicates how we might want to formulate an analysis of epistemic indefinite uses of *some*. If we follow our DS and TCL model, the epistemic use should come from a compositional account in which elements of the context of use of *some* reinforce this interpretation. Since our results are very much dependent on the kinds of context we choose, what context we use to analyze this epistemic use is an important question we need answer. With the right notion of context, the DS model of composition could then in principle tell us which contextual elements reinforce this interpretation.

There is also the question about what the various latent dimensions represent. Does each one of them in fact represent an aspect of the semantics of a determiner? Even the ones we can’t interpret? If they don’t represent semantic aspects, what do they represent? We don’t know the answers to this question, but we feel that these are important questions to ask and to resolve for those who are using DS methods and believe that DS can offer an explanatory, theoretically satisfying model of meaning. A related question is, what about the differences we noticed across our two corpora? Some dimensions of meaning were more widespread in one space than another; in some spaces a dimension could be more amenable to interpretation than in others. Do these indicate a difference in semantics too?

4.2. On the cherry picking argument

The questions in the preceding subsection highlight a difficulty in studying latent dimensions of meaning using DS methods. If we can’t interpret some dimensions or don’t see any semantic relevance in them, then our selection of certain dimensions as being semantically informative can seem suspect. Looking through latent dimensions and “cherry picking” the ones we find interesting doesn’t seem like the right way to do semantics as a science. However, once we see that differences in content in dimensions lead to shifting in composition and we can empirically

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14These questions become all the more pressing once researchers start to exploit nonlinear and neural net methods for representing word meaning, as such architectures are intrinsically much more difficult to interpret than the linear algebraic techniques we use here.
test the effects of composition, the cherry picking argument loses its force. In addition, the fact that some of our dimensions are grammaticalized in some languages attests to their semantic relevance. The cherry picking argument, however, still points out a potential embarrassment about the dimensions that we can’t interpret. Our inability to explain aspects of the model hampers its theoretical power.

4.3. The content vs. functional distinction

Logical and lexical aspects of meaning do not map neatly to two different types of words. There is no purely logical vocabulary nor purely lexical/conceptual vocabulary. Instead, this distinction cross-cuts word boundaries. The meanings of lexical as well as logical words have both logical aspects (their model-theoretic meaning) and lexical/conceptual aspects. We cannot neatly separate grammar and conceptual knowledge because they are packaged together within lexical entries. Similarly, the boundary between shiftable and unshiftable content does not map neatly to lexical vs. functional vocabulary: both closed and open class words can have shiftable and unshiftable aspects to their meaning.

Though our study described above is still work in progress, it suggests that there are aspects of the meaning of quantificational determiners that might shift, namely the conceptual content that they have on top of their logical meaning. We suspect that this is the case at least for the quantifiers that have such meanings, e.g. *some*, though probably not the determiner *a*. Assuming that the conceptual meaning of determiners also includes at least some reflex of their logical meaning (Szymanik and Zajenkowski 2010), we can say that there are parts of the conceptual content of quantificational determiners that might shift, and there is also a part of their conceptual content that is invariant with context. The first type of conceptual meaning corresponds to the semantic dimensions that distributional semantics can uncover. The second type of conceptual meaning is the conceptual reflex of the logical meaning of these items.

For example, in the case of the determiner *some*, the conceptual reflex of the existential quantification is non-shiftable. However, the other conceptual effects associated with it, e.g. uncertainty about identity, measure readings, kind readings, partitive readings, etc. might be shiftable.

5. Conclusion

In this paper we have argued, based on findings from Distributional Semantics, that both function and content words have lexical/distributional content in addition to their logical content. Our results, based on a preliminary study of determiners, indicate that the difference between the two types of words is a difference in degree rather than being categorical. These findings, if correct, have implications both for distributional and formal semantics. For distributional semantics, they indicate a possible avenue that can be used to tap into the meaning of function words. For formal semantics, they bring into light the context-sensitive, lexical aspects of function words that can be recovered from the data even when these are not overtly marked. Such pervasive context-sensitivity has profound implications for how we think about meaning in natural language.
References


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**Content vs. function words**
Korean classifier-less number constructions
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Abstract. Korean is a generalized classifier language where classifiers are required for numerals to combine with nominals. This paper presents a number construction where the classifier is absent and the numeral appears prenominally. This construction, which I call the classifier-less number construction (Cl-less NC), results in a definite or a partitive reading where the referent must be familiar: ‘the two women’ or ‘two of the women’. In order to account for this, I argue that Korean postnominal number constructions are ambiguous between a plain number construction and a partitive construction. After motivating and proposing an analysis for the partitive structure, I argue that Cl-less NC is derived from the partitive construction, explaining its distributional restriction and the interpretation.

Keywords: number construction, classifiers, partitives, Korean.

1. Introduction

Korean is a generalized classifier language where classifiers are required for numerals to combine with nominals. However, the language allows a construction where the classifier is absent and the numeral appears prenominally in some contexts, as shown in (1). Unlike the regular number construction shown in (2), (1) results in a definite or a partitive reading where the referent of women is familiar. I call the classifier-less number construction (Cl-less NC). The existence of such construction has been noted before in the literature, but it was assumed to be a special case of direct combination of a small class of human or body-part denoting nouns with numerals (cf. Choi, 2005; Shin, 2017). That this construction results in a different meaning from the regular number construction is a new observation that, as far as the author knows, has not been discussed in the literature.

(1) sey yeca
three woman
‘the three women’ or ‘three of the women’ [Cl-less NC]

(2) yeca sey-myeng
three woman-CL
‘three women’ [Regular NC]

The focus of this paper is to introduce this construction, discuss its distribution and the resulting meaning more carefully in comparison to other number constructions in the language, and propose a possible analysis. I start in Section 2 with an overview of Korean nouns in argument positions, discussing how numerals combine with nouns, and how definiteness is marked. Against this background I will closely examine the meaning of the Cl-less NC in Section 3. It will be shown that the Cl-less NC seems to have a definite, anaphoric reading, but does not

1I would like to thank Gennaro Chierchia, Uli Sauerland, and my Korean consultants for their helpful comments. All errors are mine.
require maximality. In Section 4, I present my proposal. I argue that Korean postnominal number constructions are ambiguous between two structures, one which is a plain, indefinite construction and the other which is a partitive construction. After I motivate the structure for the partitive construction, I argue that the Cl-less NC derives from the partitive structure and discuss how the proposal accounts for the properties discussed in Section 3.

2. Background: Korean bare nouns and number phrases

Korean bare nouns — nouns without a determiner — are similar to bare nouns in other classifier languages such as Mandarin and Nuosu Yi in that they can appear in argument positions and allow kind and generic readings (cf. Kang, 1994; Nemoto, 2005; Jiang, 2017; a.o.).

(3) koray-nun phoyuryu-i-ta.
    whale-TOP mammal-COP
‘Whales are mammals.’
    (Nemoto, 2005) [Kind]

(4) kay-nun cicnunta.
    dog-TOP bark
‘Dogs bark.’
    (Kang, 1994) [Generic]

In addition, similar to Mandarin, Korean bare nouns allow indefinite, definite, and plural indefinite readings (cf. Kang, 1994 and Nemoto, 2005 for detailed discussion of Korean and Japanese).

(5) na-nun ecey chayk-ul sa-ss-ta.
    I-TOP yesterday book-ACC buy-PST-DECL
‘I bought books/a book/the book yesterday.’

Definite readings of bare nouns need a closer look. Investigating the distinction between uniqueness-denoting definites (‘weak definites’) and familiarity-denoting definites (‘strong definites’) proposed in Schwarz (2009), scholars have argued that Korean bare nouns correspond to weak definites (Cho, 2016; Ahn, 2017). For example, Korean bare nouns appear in the globally unique context in (6), and in the situationally unique context in (7).

(6) amsuthulong-un inlyu-sasang choycholo tal-ey chaklyukhay-ss-ta.
    Armstrong-TOP man-history first moon-DAT land-PST-DECL
‘Armstrong was the first to land on the moon in human history.’
    [Global Unique]

(7) taythonglyeng-i hayngsa hyencang-ul pangmwunhay-ss-ta.
    president-NOM event venue-ACC visit-PST-DECL
‘The president visited the event venue.’
    [Situational Unique]

Bare nouns allow anaphoric readings as shown in (8), but such cross-sentential anaphora are also compatible with uniqueness-based analyses (cf. Ahn, 2017).
When a covarying interpretation is needed, a bare noun is not felicitous, and instead, an anaphoric marker *ku* is obligatory. Traditionally, *ku* in Korean has been analyzed as a distal demonstrative (Sohn, 1994; Chang, 2009; a.o.), but as Ahn (2017) argues, it is more appropriate to analyze *ku* as an anaphoric marker, because it resists an exophoric use where referents are pointed to, and only refers to entities that are familiar to the speaker and the hearer. This corresponds to the distribution of strong, familiar-denoting definites discussed in Schwarz (2009).

In (9) shown below, the anaphoric link between the antecedent (the book on truffles in each library) and the pronoun is not necessary without *ku*. Without *ku*, the more natural reading is that in each library that has a book about truffles, I borrowed some books, not necessarily that particular book about truffles. With *ku*, on the other hand, the referent of *ku* _chayk* must covary with the quantified antecedent. Throughout this paper, I gloss *ku* simply as KU to avoid suggesting a specific analysis.


‘In every library that has a book about truffles, I checked out the book.’

In anaphoric cases, plural marking is required in Korean. While Korean plural marking has been assumed to be optional, Kim (2005) argues that the plural marker -_tul_ is obligatory in demonstrative constructions. In (10), for example, where *ku* _yeca-tul_ in the second sentence refers to the same three women the speaker saw yesterday, plural marking is obligatory.


see-PST-DECL.

‘Yesterday I saw three women. Today, I saw the women again.’

The obligatoriness of plural marking is not dependent on the presence of *ku*, however, as shown in (11). As long as the speaker intends to refer back to the three women she saw, plural marking is obligatory (Ahn and Snedeker in prep).


seem-PST-DECL

‘Yesterday I saw three women. They/the women looked nervous.’

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2In Kim, the term ‘demonstrative’ is used traditionally to include not only the distal *ce* and the proximal *i* but the anaphoric *ku*. 
As Kim (2005) notes, number constructions constitute an exception to this plural marking requirement. When a number construction appears with a demonstrative, plural marking is not necessary, and in fact not felicitous. This is shown in (12) where a) adding the plural *tul* is odd, and b) the reading of *ku yeça sey-myeng* (‘the three women’) remains anaphoric without the plural.

(12) na-nun ecey yeça sey-myeng-ul pwassta. onul tto ku yeça-(?tul)
    I-TOP yesterday woman three-CL-ACC saw. today again KU woman-(PL)
    sey-myeng-ul pwa-ss-ta.
    three-CL-ACC see-PST-DECL.
    ‘Yesterday I saw three women. Today, I saw the three women again.’

2.1. Korean number constructions

The structure for NumP assumed in this paper is shown below. I follow Choi (2005) in arguing that Korean nominal domain should be analyzed with a head-initial structure, and that the NP moves to the spec of NumP for linear order (also see Simpson et al., 2005 for a similar structure in other languages).

(13) yeça sey-myeng
    woman three-CL
    ‘three women’

In addition to the postnominal construction in (13), Korean also allows a prenominal construction as shown in (14), and a floating quantifier construction as shown in (15) (cf. Choi, 2005; Shin, 2017). The prenominal construction involves a genitive-marked Num-Cl construction that precedes the noun, and the floating construction involves either a case-marked (15b) or a non-case-marked (15a) Num-Cl constituent that appears to be separated from the noun. Whether these are derived from the postnominal construction or not is still debated, but I focus only on the postnominal construction for this paper and refer interested readers to works like Ko (2005) and Shin (2017) for detailed syntactic and semantic discussions.

(14) sey-myeng-uy yeça
    three-CL-GEN woman
    ‘three women’

(15) a. yeça-ka sey-myeng wa-ss-ta.
    woman-NOM three-CL come-PST-DECL
    ‘Three women came.’

    [Prenominal]

    [Floating Quantifier]
Korean classifier-less number constructions

b. yeca-ka sey-myeng-i wa-ss-ta.
   woman-NOM three-CL come-PST-DECL
   ‘Three women came.’ [Case-marked Floating Quantifier]

Korean number phrases result in an indefinite reading, as shown by the example below.

(16) na-nun ecey yeca sey-myeng-ul pwassta. onul tto yeca sey-myeng-ul
   I-TOP yesterday woman three-CL-ACC saw. today again woman three-CL-ACC
   pwa-ss-ta.
   see-PST-DECL.
   ‘Yesterday I saw three women. Today, I saw three women again.’

In (16), the three women the speaker saw today are not the three women she saw the day before. It is infelicitous to use the regular number construction to refer to the same women anaphorically.

Thus, what we have seen so far is that Korean bare nouns allow kind, generic, indefinite, and weak definite readings. In strong definite readings, ku is obligatory. Number constructions in Korean require classifiers and receive indefinite readings. When ku or the plural marker tul is added, a number construction in Korean receives a definite, maximal reading. I discuss a new observation that Korean sometimes allows the classifier to be absent in certain contexts. What stands out about this construction is that unlike other number constructions possible in the language, it is restricted to an anaphoric, or a partitive anaphoric reading: ‘the two women’ or ‘two of the women’.

3. Classifier-less number construction

In Cl-less NC, the numeral appears prenominally without a classifier.³

(17) sey yeca
    three woman
    ‘the three women’

The presence of phrases like sey yeca has been noted in the literature, but it has been analyzed as certain human or body-part denoting nouns directly combining with numerals (Choi, 2005; Shin, 2017). However, Cl-less NC is not restricted to human or body-part nouns. In appropriate contexts, inanimates can appear in this construction too, as the examples below show.

(18) twu uyca-(lul) ta kacyewa.
    two chair-ACC all bring.IMP
    ‘Bring both chairs.’

³Here, I am only focusing on the Korean numerals rather than Sino-Korean numerals which do combine directly with certain measure nouns such as ‘centimeter’ and ‘liter’. With Sino-Korean numerals, measure words seem to take the role of the classifier. With Korean numerals, however, classifiers are obligatory.
Moreover, the construction is restricted to simplex numerals from two to nine. For example, (20a) is felicitous, while (20b) sounds odd. While we are dealing with gradient judgements need more empirical data to confirm this, the generalization from consulting five Korean speakers was that the higher the number, the less felicitous the construction became.

\[(20)\]
\[
a. \text{yeset namca-nun wus-ess-ta.} \\
\text{six man-TOP smile-PST-DECL} \\
\text{‘The six men smiled.’}
\]
\[
b. \text{???yel.han namca-nun wus-ess-ta.} \\
\text{eleven man-TOP smile-PST-DECL} \\
\text{(Intended) ‘The eleven men smiled.’}
\]

This restriction cannot be explained by an account that proposes a direct combination of nouns. Instead, the restriction seems to come from structural constraints. I explore this idea further in my analysis.

Another property of Cl-less NC is that plural marking cannot co-occur with the construction, as shown in (21).

\[(21)\]
\[
\text{sey yeca-(*tul) woman-PL}
\]

Semantically, what is interesting about this construction is that it receives what looks like an anaphoric or an anaphoric partitive interpretation. That is, \text{sey yeca} in (17) can be interpreted as ‘the three women’ or ‘three of the women’. The referent women must be familiar to both the speaker and the hearer. I discuss the definite-like interpretation in more detail below.

3.1. Definite reading

Cl-less NC is notable in that it is restricted to a definite or a definite partitive reading. More specifically, it requires the referent to be familiar. It resists an indefinite reading, as the oddness of a presentational context in (22) shows. This was confirmed by six native speakers.

\[(22)\]
\[
pang-ey twu yeca-ka exist-ess-ta. \\
\text{room-DAT two woman-NOM exist-PST-DECL} \\
\text{‘The two women were in the room.’} \\
\text{[# Presentational]}
\]
The anaphoric reading is evident in the following two examples. The first involves a sentential anaphora, where "two women" in the second sentence must refer anaphorically to the two women that came.

(23) yeca twu-myeng-kwa namca-ka tulewa-ss-ta. twu yeca-nun
    woman two-CL-CONJ man-NOM come.in-PST-DECL. two woman-TOP
    yeyp-p-ess-ta.
    pretty-PST-DECL.
    'Two women and a man came. The two women/*Two women were pretty.' [Anaphoric]

The second involves a donkey type covarying example, where the referent of "three child" must be the three children of each mother that the universal quantifier ranges over.

(24) ai sey-myeng-ul twu-n motwun emma-nun sey ai-lul tokkathi iphinta.
    child three-CL-ACC have-RC every mother-TOP three child-ACC same dress
    'Every mom who has three children dresses *(the) three children the same.' [Donkey]

There are three alternative constructions that result in the same covarying reading. These all make use of the anaphoric ku: ku with the full postnominal number construction in (25a), ku with plural tul in (25b), and ku with the Cl-less NC in (25c). Recall that Cl-less NC is not possible with plural marking, so adding a plural marker in (25c) would be infelicitous.

(25) ai sey-myeng-ul twu-n motwun emma-nun ...
    child three-CL-ACC have-RC every mother-TOP
    'Every mom who has three children...'
    a. ku ai sey-myeng-ul tokkathi iphinta.
       KU child three-CL-ACC same dress
       'dresses the three children the same.'
    b. ku ai-tul-ul ...
       KU child-PL-ACC
    c. ku sey ai-(*_tul)-ul ...
       KU three child-PL-ACC

If only plural tul is present without ku, it has two readings: one that is identical to the covarying reading above, and another that refers to a different set of contextually salient children. For example, if there is a class full of children, and each week one of the mothers dresses the whole class, (26) could mean that every mom who has three children dresses the whole class the same.

(26) ai sey-myeng-ul twu-n motwun emma-nun ai-tul-ul tokkathi iphinta.
    child three-CL-ACC have-RC every mother-TOP child-PL-ACC same dress
    a. 'Every mom who has three children dresses the three children the same.'
    b. 'Every mom who has three children dresses the children the same.'

Thus, we see that Cl-less NC behaves just like a number construction that is accompanied by ku, or a noun accompanied by both ku and plural tul. Another property Cl-less NC shares with ku and tul is that it always receives a wide-scope reading, unlike specific indefinites that
allow quantificational or intermediate scope (Fodor and Sag, 1982; Ionin, 2006). Specifically, indefinites are ambiguous between quantificational and referential readings as shown in (27): either Mary read every book that a specific teacher recommended, or any book that any teacher recommended. Indefinites also allow intermediate scope as shown in (28): the resulting reading is that for every student, there was some teacher such that the student read every book that the teacher recommended.

(27) Mary read every book a teacher recommended. (Fodor and Sag 1982)

(28) Every student read every book that some teacher (of hers) had recommended.

The same kinds of ambiguity is available in number constructions in English.

(29) Mary read every book two teachers recommended.

(30) Every student read every book that two teachers (of hers) had recommended.

Cl-less NC in Korean, however, only allows the referential, wide-scope reading:

(31) Jimin-un twu yeca-ka chwuchenhan motun chayk-ul ilk-ess-ta
    Jimin-TOP two woman-NOM recommended-RC every book-ACC read-PST-DECL
    ‘Jimin read every book two women recommended.’

(32) motun haksayng-un twu yeca-ka chwuchenhan motun chayk-ul
    every student-TOP two woman-NOM recommended-RC every book-ACC
    ilk-ess-ta
    read-PST-DECL

    ‘Every student read every book the two women recommended.’

The same pattern is shown by the full number construction with ku (ku yeca twu-myeng) and the noun with ku and plural marking (ku yeca-tul), as well as ku with Cl-less NC (ku twu yeca).

Thus far, we have seen that Cl-less NC receives a definite meaning, just like the full postnominal number construction with anaphoric ku or the noun with ku and plural marking tul. In the next section, I present one important property that distinguishes the Cl-less NC from others: the lack of the maximality requirement.

3.2. No requirement of maximality

The data discussed so far suggests that the Cl-less NC results in a definite, anaphoric interpretation. However, the construction does not always require maximality, which is not compatible with the hypothesis that Cl-less NC is definite. For example, in (33), the reference to two of the women out of the three who came is possible with the Cl-less NC.

(33)
This lack of maximality requirement is what distinguishes Cl-less NC from other constructions that make use of *ku* or plural marking *tul*. Compare this with the construction with *ku* in (34) and with the plural marker *tul* in (35) below, where maximality is required.

(34) yeca sey myeng-i wassta. {*ku twu yeca / ku yeca twu-myeng}*-nun
     woman three CL-NOM came  KU two woman  KU woman two-CL-TOP
     anc-ass-ta.
     sit-PST-DECL
     ‘Three women came. The two women sat down.’

(35) yeca sey myeng-i wassta. (ku) yeca-tul-un anc-ass-ta.
     woman three CL-NOM came  KU woman-PL-TOP sit-PST-DECL
     ‘Three women came. The women sat down.’ (False if two women sat down)

The absence of a maximality requirement can be shown on the covarying example discussed above as well.

(36) ai sey-myeng-ul twu-n motwun emma-nun twu ai-lul ttokkathi iphinta.
     child three-CL-ACC have-RC every mother-TOP two child-ACC same dress
     ‘Every mom who has three children dresses two of the children the same.’

In (36), the Cl-less NC that appears in the scope of the sentence must covary with the mother that is quantified over. Thus, there is still an anaphoric link between the mother and the two of the children she has. However, maximality is not required, and thus, it is okay for Cl-less NC to pick out only two out of the three that the mother has.

Cl-less NC thus seems to have a (partitive) definite interpretation, where the referent must be familiar, but there is no requirement of a maximal reference. There is one exception, which is the numeral one. Unlike other simplex numerals, *han* (‘one’) in a Cl-less NC allows an indefinite reading that is shown in the presentational example in (37).

(37) enu maul-ey han wang-i sal-ass-ta.
     some village-DAT one king-NOM live-PST-DECL
     ‘There lived a king in some village.’

Numeral one does appear in partitive definite contexts, as shown in (38), but it resists a definite reading that refers to a familiar entity. For example, in (39), *han yeca* cannot refer to the same woman that came.

(38) yeca sey myeng-i wassta. han yeca-nun anc-ass-ta.
     woman three CL-NOM came  one woman-TOP sit-PST-DECL
     ‘Three women came. One of the women sat down.’
(39)  yeca han myeng-i wassta. han yeca-nun anc-ass-ta.
    woman one CL-NOM came   one woman-TOP sit-PST-DECL
    ‘One woman came. One woman sat down.’

In the next section, I suggest one possible analysis of Cl-less NC, where it is a partitive structure with a familiar entity for the referent. I start with a general proposal of Korean number constructions where they are ambiguous between a plain indefinite construction and a partitive construction, and then suggest that the Cl-less NC is derived from the partitive construction.

4. Proposal

Following other works on classifier languages such as Chierchia (1998b), Dayal (2004), Jiang (2012), and others, I assume that Korean bare nouns are kind-denoting, and that a classifier is what turns kinds into sets of object level individuals, as shown in (40) and (41).

\begin{align*}
\{\text{CL}\} &= \lambda k \lambda x \left[ \text{AT}(\bigcup k(x)) \right] \\
\text{AT}: &\text{predicate denoting set of atoms}
\end{align*}

(40) \hspace{1cm} (41)

In addition to these assumptions, I make the following proposals. First, I argue that Korean number construction is ambiguous between the plain structure in (43) and the partitive structure in (44). Second, I argue that the Cl-less NC is derived from the partitive structure, which accounts for its distribution and interpretation.

(43) \hspace{1cm} (44)
The structure in (43) is repeated from above, where NP is assumed to move to the specifier position of NumP as Choi (2005) proposes. The partitive structure in (44) is inspired by the claim in Shin (2017) that the postnominal construction is a true partitive, though the structure I propose is quite different. For instance, in Shin (2017), the partitive structure does not involve two noun positions with ellipsis, and the partitive meaning is lexically encoded in the classifier. Moreover, unlike Shin who argues that all postnominal constructions are true partitives, I assume that the partitive structure is only made available when necessary. In regular, indefinite contexts, (43) is sufficient, so (44) is not motivated.

In (44), a PartitiveP projected above the plain NumP has an abstract [+part] head with a DP yeca (written with women for clarity) in its specifier. I assume an analysis of partitives that involves two noun positions with ellipsis targeting one or both of the two nouns (Jackendoff, 1977; Sauerland and Yatsushiro, 2017; a.o.). There is one crucial difference between partitive constructions proposed in works like Sauerland and Yatsushiro (2017) and the one proposed here, which is the order of the arguments. In Sauerland and Yatsushiro (2017), the partitive first takes as its argument the whole NP which provides the domain, and then takes the unit NP which specifies how many. In (44), [+part] first takes as its argument the NumP and then the DP. Thus, I call the first woman in the DP the whole NP, and woman in spec of NumP the unit NP. In (44), I argue that the unit NP is ellided because the null [+part] requires some lexical element to its left to incorporate into.

While the structure in (44) has not been proposed for Korean partitives or number constructions prior to this paper, motivations can be found from constructions in Korean that seem to involve an overt counterpart of [+part]. Specifically, the interpretation of (45) where the anaphoric ku is followed by cwung (‘among’, ‘between’) and a number construction is that of a partitive.

(45) ku cwung ai twu-myeng
    KU among child two-CL
    ‘two of the children’ [http://blog.naver.com/chic_sisters/220089721837]

Because ku requires a nominal argument except when it is a singular masculine pronoun, one could analyze this as involving ellipsis of the NP ai as in (46). The ellided NP serves as the whole NP, so (45) can be analyzed as having the same partitive structure as (44).

(46) ku æ kwung ai twu-myeng

\[
\text{PartP} \\
\text{DP} \\
\text{kwu æ} \\
\text{cwung} \\
\text{NumP} \\
\text{NP}_i \\
\text{ai} \\
\text{Num} \\
\text{twu} \\
\text{ClP} \\
\text{Cl} \\
\text{ti} \\
\text{myeng}
\]
Note that it is also possible to pronounce both NPs in (46), further supporting the structure in (44). Thus, if we argue that [+part] is a covert variant of *cwung* that appears in partitive structures, both the structure and the ellipsis process can be motivated.

The semantics for the [+partitive] head is similar to the entry proposed for partitives in other works such as Ionin and Matushansky (2006) and Sauerland and Yatsushiro (2017), but different in the order in which the arguments are taken: as mentioned above, the NumP consisting of the unit NP is taken as the first argument of [+part].

\[(+\text{part}) = \lambda P \lambda y \lambda x [P(x) \land x \leq y]\]

With these semantic entries the meanings of the two constructions can be composed. In both the plain number construction and in the partitive construction, the classifier combines with the kind-denoting noun *yeca* (*woman*), resulting in (48). Then, the numeral *sey* is combined in (49). Note that while I follow Dayal (2012) in using a shorthand 3 in (49), the full form of which is shown in (49a).

\[[\text{Cl NP}] = \lambda x [\text{AT}^\text{\text{-}3}\text{woman}(x)]\]

\[[3 \text{ Cl NP}] = \lambda x [\text{AT}^\text{\text{-}3}\text{woman}(x) \land 3(x)]\]

\[[3 \text{ Cl NP}] = \lambda x [\text{AT}^\text{\text{-}3}\text{woman}(x) \land 3(x) \land x \leq \iota y[y\text{woman}(y)]]\]

This is the semantics of the plain number construction in (43), where the property is turned into an argument using common type-shifting operators (Dayal, 2012; Chierchia, 1998b; a.o.).

For the partitive construction, the resulting property in (49) is further taken as an argument of [+part], resulting in (50), which then combines with the DP. For (44), I assume that the DP takes a unique *yeca* in the context, but the DP can involve *ku*, resulting in an anaphoric reference.

\[[+\text{part }3 \text{ Cl NP}] = \lambda y \lambda x [\text{AT}^\text{\text{-}3}\text{woman}(x) \land 3(x) \land x \leq \iota y[y\text{woman}(y)]]\]

Thus, (44) is true of any x such that x is composed of woman atoms, has a cardinality of three, and is a part of ‘the women’. This results in a partitive construction that has a definite referent.

Note that, on the surface, the plain number construction and the partitive construction cannot be distinguished. The partitive construction would only be motivated when proper subsethood reading to a familiar referent is required, as in (52).

\[[+\text{part }3 \text{ Cl NP}] = \lambda y \lambda x [\text{AT}^\text{\text{-}3}\text{woman}(x) \land 3(x) \land x \leq \iota y[y\text{woman}(y)]]\]

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4.1. Accounting for the Cl-less Construction

In the last section, I proposed that Korean postnominal number construction is ambiguous between two structures: the plain number construction that results in an indefinite reading, and the partitive construction with a familiar referent. The two constructions are not distinguishable on the surface because of the same ordering of the noun, the classifier, and the numeral. The Num Noun order of the Cl-less NC, however, is only compatible with one of the two structures, namely the partitive construction. I show in the rest of this section that the Cl-less NC is derivable from the partitive construction, and discuss how its properties can be accounted for.

In order to derive the Cl-less NC, I first focus on the distinction between complex and simplex numerals. I argue that simplex numerals, unlike complex numerals that require a full NumP (Ionin and Matushansky, 2006), can appear as simple Num heads. I will further argue that this allows simplex numerals to move, unlike complex numerals. Such constraints on the movement of larger items have been seen elsewhere, such as in V2 movements in German.

Second, I argue that in Cl-less NC, the classifier head is null. I argue that this has consequences for linear order. The numeral that usually appears with a classifier differs in form from numerals used in counting in that it is adjectival. For example, while counting numbers are of the form in (53), numerals that appear with classifiers are shorter and require the lexical element that is modified to appear on the right.

(53) Counting: hana, twul, ses, nes, taset
(54) In number constructions: han, twu, sey, ney, taset

I posit that the numeral, when the classifier is null, must move to a position where there would be an appropriate lexical element to its right. Thus, I argue that the Num head moves to occupy the [+part] head. This results in the structure in (55).

(55)

In this construction, the unit NP is not ellided because sey requires a phonological element to its right due to the reason above. Thus, the whole NP in the DP argument is ellided. This, unlike the regular partitive construction, is possible now since [+part] is no longer null. The meanings compose in the same way as in the partitive construction.
4.2. Accounting for data

The characteristics of the Cl-less NC observed in the previous section are summarized below:

(56) a. Classifier is null
b. Results in a Num Noun order with no plural marking
c. Restricted to simplex numerals
d. Results in an (improper subsethood) partitive reading with a familiar referent
e. Numeral one only allows a proper subset partitive reading

In my analysis, I propose that Cl-less NC is derived from the partitive construction. This accounts for the definite-like, but not maximal reading that we saw with Cl-less NC. While in the regular partitive construction, the unit NP is ellided (because the null [+part] requires a lexical element to its left to incorporate into, and thus the whole NP cannot be ellided), in Cl-less NC, I argue that the whole NP (the DP argument) is ellided. This was motivated by two processes: a) movement of the Num head into [+part] head, licensing it, and b) the adjectival numeral *sey requiring a nominal element to its right. I argue that the movement of Num head is only possible when the numeral is occupying the Num head position, and this accounts for the restriction to simplex numerals. The adjectival nature of the numeral is not an issue when there is a classifier, but because there is no classifier, movement is triggered to position the numeral before some lexical element. The movement of the Num head to the [+part] head and the ellision of the whole NP (the DP argument) together account for the right Num Noun order.

I follow Sauerland and Yatsushiro (2017) in assuming that when the whole NP is ellided, proper subsethood is not required. This means that the partitive construction in principle can be used for improper subset partitives such as ‘two of the two women’, which is semantically not distinguishable from the regular ‘the two women’. Thus, the anaphoric uses found with Cl-less NC with improper subsethood are also accounted for.

What about numeral one which receives an indefinite reading and a proper subset partitive reading, but no definite reading? One possible reason for the absence of the definite reading is a competition with a simpler alternative, which is the bare noun. For example, in (39) repeated below, one could use the bare noun.

(57) ye ca han myeng-i wassta. han ye ca-nun anc-ass-ta.
    woman one CL-NOM came one woman-TOP sit-PST-DECL
    ‘One woman came. One woman sat down.’

(58) ye ca han myeng-i wassta. ye ca-nun anc-ass-ta.
    woman one CL-NOM came woman-TOP sit-PST-DECL
    ‘One woman came. The woman sat down.’

The use of the marked Cl-less NC may suggest that the speaker did not have enough information to use the less marked counterparts. This pragmatic story could account for why numeral one resists a definite, maximal reading, and is desirable because it would only work with numeral one, which the bare noun competes with, but not other numerals.
Recall that maximality was required when *ku* was added to the Cl-less NC. This can be done straightforwardly by the following structure, if *ku* is analyzed as a strong definite that adds the meaning of *ι* with an index (Ahn, 2017).

(59) DP
   ku
   PartP
   DP
   yeca
   2, [+part]
   NumP
   NP
   yeCA
   CIP
   ∅
   tj

(60) \[ [ku, yeCA sey yeCA]^g = tx [\text{AT}^{\text{yeCA}}(x) \land 3(x) \land x \leq ty[yeca(y)] \land x = g(i)] \]

Lastly, plural marking in some classifier languages is analyzed as a plural classifier (Dayal, 2012). If we assume that Korean plural marking is also a classifier, the empirical observation that the Cl-less NC does not co-occur with plural marking may be explained. The consequences of analyzing Korean plurals as a classifier should be further investigated.

5. Conclusion

In this paper, I presented a new observation that Korean sometimes allows the classifier to be dropped in a number construction, in which the numeral appears prenominally. The resulting meaning of this Cl-less NC was closely investigated, showing that while Cl-less NC resembles a definite, anaphoric reading that results from adding the anaphoric marker *ku* to a number construction, there is no requirement of maximality. In order to account for this meaning, I first proposed that Korean postnominal number construction is ambiguous between a plain, indefinite construction and a partitive construction. The structure for the partitive construction where there is a covert [+part] head was motivated by an overt counterpart that makes use of *cwung* (‘among’). Then, I argued that Cl-less NC is derived from the partitive construction.

There are remaining details to be worked out. For example, one of the main novelties of the partitive structure I proposed is that the order of the arguments is flipped. It would be worth investigating how this is related to the assumption of head initialness that I adopted from Choi (2005). Also, while the absence of an overt classifier in Cl-less NC is compatible with the partitive construction in which the Num head moves to the partitive head position, it is not yet clear whether this movement would be necessary. These issues are left for future investigation.

References

Quantification in event semantics: Generalized quantifiers vs. sub-events

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Abstract. The goal of this paper is to evaluate two approaches to quantification in event semantics, namely the analysis of quantificational DPs in terms of generalized quantifiers and the analysis proposed in Schein (1993) according to which quantifiers over individuals contain an existential quantifier over sub-events in their scope. Both analyses capture the fact that the event quantifier always takes scope under quantifiers over individuals (the Event Type Principle in Landman (2000)), but the sub-events analysis has also been argued to be able to account for some further data, namely for adverbs qualifying ‘ensemble’ events and for mixed cumulative/distributive readings. This paper shows that the sub-events analysis also provides a better account of the Event Type Principle if a broader range of data is considered, including cases with non-existential quantifiers over events: unlike the generalized quantifiers analysis, it can successfully account for the interpretation of indefinites in bare habituals and sentences that contain overt adverbs of quantification.

Keywords: quantification, event semantics, generic quantifier, habituals, Q-adverbs.

1. Introduction

In semantic systems that do not take events to be a basic semantic type, the interpretation and semantic behavior of quantificational DPs (QPs) have been intensely studied and are comparably well understood. QPs are standardly assumed to denote generalized quantifiers, type \( \langle et, t \rangle \), which implies an asymmetry between subjects and non-subjects: differently from subject QPs, non-subjects produce a type clash in their base positions. This type clash is avoided by assuming that non-subject QPs undergo Quantifier Raising (QR) to a position of type \( t \) (S/IT/TP or VP/vP if subjects are generated VP/vP-internally), and Quantifier Raising is also used to model quantifier scope ambiguities. This state of affairs is schematically represented below.

\[
(1) \quad S_t \quad \begin{array}{c} \text{NP}_{\langle et, t \rangle} \quad \text{VP}_{\langle et, t \rangle} \\
\quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \quad \Quad...
the type composition in the lower verbal domain of a transitive clause, where \( v \) is the type of events.\(^2\)

\[(2)\]

\[
\text{VoiceP}_{(v,t)} \\
\rightarrow \text{DP} \quad \text{Voice'}_{(e,vt)} \\
\quad \text{Voice} \quad \text{VP}_{(v,t)} \\
\quad \text{V}_{(e,vt)} \quad \text{DP} \\
\lambda x. \lambda e. [V(e) \land \text{theme}(x)(e)]
\]

In this configuration, there is no asymmetry anymore between subjects and non-subjects: the sister constituents of the subject and object DPs in (2) have the same semantic type. Despite this difference from eventless frameworks, the analysis of quantificational DPs in terms of generalized quantifiers can be straightforwardly adopted also here, as is done, for instance, in Landman (2000). In this case, being of type \( \langle et, t \rangle \), quantificational subjects and non-subjects alike must for type reasons obligatorily undergo QR to a position of type \( t \), i.e. to TP.

However, the type composition in (2) also allows for an alternative treatment of QPs, namely as expressions of type \( \langle \langle e, vt \rangle, vt \rangle \). In this case, QR to TP is not possible, but quantificational DPs can be interpreted in situ or be optionally QRed to VoiceP (position of type \( \langle v, t \rangle \)) for scope reasons. This kind of analysis was first proposed in Schein (1993), whose semantics of quantificational DPs contains a variable ranging over ‘ensemble’ events (sum events) and one ranging over sub-events (part events) and introduces an existential quantifier over sub-events in the scope of the quantifier over individuals. Thus, while the generalized quantifier semantics of, e.g., every girl is as in (3), Schein’s semantics of it is as in (4), where \( \sqsubseteq \) is a part-of relation.

\[(3)\]  
\[
[\text{every girl}] = \lambda P. \forall x[\text{girl}(x) \rightarrow P(x)]
\]

\[(4)\]  
\[
[\text{every girl}] = \lambda P. \lambda e. \forall x[\text{girl}(x) \rightarrow \exists e'[e' \sqsubseteq e \land P(x)(e')]]
\]

Both analyses capture the fact that the event quantifier always takes scope under quantifiers over individuals (cf. the Event Type Principle in Landman (2000)): due to obligatory QR to TP in the generalized quantifier analysis (GQ analysis, henceforth) and due to the presence of an existential quantifier over sub-events in the sub-event analysis (SE analysis, henceforth). However, the SE analysis has also been argued to be able to account for some further data, namely for adverbs qualifying ensemble events and for mixed cumulative/distributive readings (cf. Schein, 1993; Kratzer, 2002; Ferreira, 2005), which will be discussed in more detail below in section 2.

The goal of this paper is to show that, in fact, the SE analysis also provides a better account of the Event Type Principle if a broader range of data is considered. So far, it has mainly been

\(^2\)Here and below, I do not differentiate between \( \nu P \) (Chomsky, 1995) and \( \text{VoiceP} \) (Kratzer, 1996), whose role is to introduce the external argument in their specifier positions.
cases involving a universal quantifier over individuals and an existential quantifier over events (i.e., episodic interpretation) that have been looked at when comparing the GQ analysis and the SE analysis. The paper extends the scope of this comparison to the inverse configuration, that is, to cases with an existential quantifier over individuals and a generic or universal quantifier over events, and shows that the SE analysis but not the GQ analysis can successfully account for the interpretation of indefinites in bare habituals and in sentences that contain overt adverbs of quantification.

The structure of the paper is as follows. Section 2 introduces the SE analysis and discusses the advantages that it has been claimed to have over the more traditional GQ analysis. Section 3 presents data concerning bare habituals and sentences with adverbs of quantification which have not been considered yet in connection with the comparison between the GQ analysis and the SE analysis and which form the empirical basis of the paper. Subsequently, sections 4 and 5 discuss two alternative approaches to the semantics of habituality and evaluate the GQ analysis and the SE analysis with respect to how successful they are in modeling the interpretation of indefinites in bare habituals and overtly quantified sentences, given that these approaches to habituality are adopted. In particular, section 4 shows that neither of the two analyses produces the desired results if a quantificational approach to habituality in terms of a generic quantifier is adopted. In turn, section 5 presents an alternative non-quantificational approach to habituality and shows that in combination with it, the SE analysis can successfully account for the semantic behavior of indefinites in bare habituals and overtly quantified sentences, whereas the GQ analysis cannot. Section 6 concludes.

2. Quantification and events

This section introduces the main features of the SE analysis of QPs in comparison with the more traditional GQ analysis and the reasons why it has been proposed. As has already been discussed in the introduction, the type composition in (2) allows QPs to be of type \( \langle \langle e, vt \rangle, vt \rangle \).

Quantificational DPs of this semantic type can either be interpreted in situ, or they can undergo optional QR to a position of type \( \langle v, t \rangle \) (for instance, VoiceP), i.e. a position at which the event argument is not quantified over yet. This implies that quantifiers over individuals introduced by such QPs will always be in the scope of the event quantifier. However, the event quantifier has been observed to take the lowest scope possible with respect to other scope-taking elements such as other quantifiers or negation (cf. Schein, 1993; Landman, 2000), as the examples below demonstrate.³

\[
\text{(5)} \quad [\text{every girl}] = \lambda P. \lambda e. \forall x [\text{girl}(x) \rightarrow P(x)(e)]
\]

John kissed every girl.

\[
\begin{align*}
\text{a.} & \quad \forall x \gg \exists e \\
\text{b.} & \quad \# \exists e \gg \forall x
\end{align*}
\]

³Throughout the paper, ‘\( \gg \)’ means ‘has scope over’.
This fact, which, following Landman (2000), I will call the Event Type Principle, is straightforwardly accounted for by the GQ analysis insofar as it requires QPs to undergo obligatory QR to a position of type $t$, i.e. above the event quantifier. By contrast, the semantics in (5) fails to account for the Event Type Principle, and for this reason Schein (1993) argues that an $\langle (e, vt), vt \rangle$ type semantics of QPs should rather be as below (repeated from (4)):

(8) $\llbracket\text{every girl}\rrbracket = \lambda P . \lambda e . \forall x[\text{girl}(x) \rightarrow \exists e'[e' \sqsubseteq e \land P(x)(e')]]$

Instead of containing just one variable ranging over events, the semantics in (8) contains two: one over ‘ensemble’ events (sum events) and one over their sub-events. The single event variable in standard (neo-)Davidsonian event semantics corresponds here to the variable ranging over sub-events, which is existentially quantified over in the nuclear scope of quantifiers over individuals. This is precisely what accounts for the Event Type Principle in this framework.

Before proceeding to the advantages that this analysis has been argued to have, I should note that, in fact, the semantics in (8) is too weak, as pointed out by Ferreira (2005). This is because it places no restrictions on the identity of the ‘ensemble’ events: thus e.g. in (6), the sum event containing individual events of kissing of a girl by John should be an event of girl-kissing by John itself, while (8) would give us that the sum event can be any event that contains events of kissing of a girl by John as its sub-events, even if it also contains other kinds of sub-events. For this reason, Ferreira (2005) suggests that Schein’s semantics of QPs should be modified such that it includes a further restriction on the sub-events which ensures that they are all of the right kind:

(9) $\llbracket\text{every girl}\rrbracket = \lambda P . \lambda e . \forall x[\text{girl}(x) \rightarrow \exists e'[e' \sqsubseteq e \land P(x)(e')]] \land \forall e'[e' \sqsubseteq e \rightarrow \exists x[\text{girl}(x) \land P(x)(e')]]$

Both Schein’s semantics in (8) and Ferreira’s semantics in (9) get the scope facts (i.e. the Event Type Principle) right, as is shown below for $\text{John kissed every girl}$ using the denotation in (9) and ignoring tense.

(10) a. $\exists e \gg \forall x \gg \exists e'$
     b. $\exists e[\text{agent(john)}(e)]$
        $\land \forall x[\text{girl}(x) \rightarrow \exists e'[e' \sqsubseteq e \land \text{kiss}(e') \land \text{theme}(x)(e')]]$
        $\land \forall e'[e' \sqsubseteq e \rightarrow \exists x[\text{girl}(x) \land \text{kiss}(e') \land \text{theme}(x)(e')]]$

However, the original motivation for the SE analysis hasn’t been to account for the Event Type Principle: the GQ analysis can account for it in a much simpler way. The reason why Schein proposed this analysis is that it can also account for some further data which are problematic for the standard GQ analysis, namely adverbs qualifying ensemble events and mixed cumulative/distributive readings. Adverbs that qualify ensemble events are illustrated in the examples
In slow progression, every organ student struck a note on the Wurlitzer.
Unharmoniously, every organ student sustained a note on the Wurlitzer for sixteen measures.

Each of the individual events of striking/sustaining of a note by an organ student cannot occur in slow progression, nor can it be harmonious or unharmonious; adverbials like in slow progression and unharmoniously can apply to sequences of events (i.e. plural events), but not to singular events. Now, the logical forms of the sentences above that employ the semantics for every organ student along the lines of (8) or (9) contain a variable ranging over sum events, so adverbials like in slow progression and unharmoniously can modify the sum event containing sub-events of individual organ students striking/sustaining a note. By contrast, no such variable is available in the representations provided by standard (neo-)Davidsonian event semantics, and hence in slow progression and unharmoniously can only apply to the individual striking/sustaining events.

Another argument in favor of the SE analysis comes from mixed cumulative/distributive readings, which Schein (1993) illustrates with examples such as the following one (see also Kratzer, 2002):

Three video games taught every quarterback two new plays.

This sentence has a reading according to which three video games is interpreted cumulatively, whereas every quarterback is interpreted distributively with two new plays in its scope: three video games (between them) taught every quarterback two (other) new plays. Neo-Davidsonian event semantics, which separates the external argument as a distinct theta-role predicate, combined with the semantics for QPs along the lines of (8)/(9), which introduces two event variables, can account for this interpretation, as the logical form below from Ferreira (2005: 25) demonstrates (again, tense is ignored):

$\exists e \exists X [\text{videogame}(X) \land |X| = 3 \land \text{agent}(X)(e) \land \forall y [\text{quarterback}(y) \rightarrow \exists e'[e' \sqsubseteq e \land \text{to}(y)(e')] \land \exists Z [\text{newplay}(Z) \land |Z| = 2 \land \text{theme}(Z)(e') \land \text{teach}(e')]]]
\land \forall e'[e' \sqsubseteq e \rightarrow \exists y [\text{quarterback}(y) \land \text{to}(y)(e') \land \exists Z [\text{newplay}(Z) \land |Z| = 2 \land \text{theme}(Z)(e') \land \text{teach}(e')]]]]$

Video games act here as the agent of the ‘ensemble’ event, whereas both quarterbacks and new plays are participants in the sub-events, and this is what allows to capture the mixed cumulative/distributive pattern. By contrast, this is not possible in an event semantic framework which does not separate the agent theta-role and does not introduce a variable ranging over ‘ensemble’ events.\(^4\)

\(^4\)See Champollion (2010), who shows that mixed cumulative/distributive readings can also be accounted for in eventless frameworks.
The goal of this paper is to show that, in fact, the SE analysis also provides a better account of the Event Type Principle than the GQ analysis if, in addition to cases involving a universal quantifier over individuals and an existential event quantifier, inverse cases with an existential quantifier over individuals and a generic or universal event quantifier are considered as well. Hence, the next section presents data concerning the interpretation of indefinites in bare habitu-

3. Bare habituality vs. overt quantification

3.1. Interpretation of indefinites

This section introduces the first crucial piece of data, which concerns the semantic behavior of indefinites in bare habitu-

Quantificational adverbs like always as well as quantificational adverbials like every morning introduce quantifiers over events or times\(^5\), which enter into scope relations with other quantifiers, as the sentences below with the singular indefinite a cigarette demonstrate. Hence, both scope configurations are available in these examples, even though only one of them is pragmatically felicitous: the wide scope reading of a cigarette suggests that the same cigarette is repeatedly smoked over a long period of time, which is in conflict with world knowledge (notice that, by contrast, a pipe or the plural indefinite cigarettes are pragmatically fine).

If GEN is indeed a quantifier like the one introduced by always or every morning, one would expect bare habitu-

\(^5\)In later sections, I will argue that Q-adverb(ial)s like always and every morning introduce quantification over times. For now I am staying neutral in this respect however, given that it is commonly assumed that Q-adverbs quantify over events.
(possibly the earliest mentioning of this fact can be found in Carlson (1977)).

(16) #John smokes a cigarette.
   a. #∀ \gg \text{GEN}
   b. *\text{GEN} \gg \exists

Note that, under the assumption that (16) contains the generic quantifier \text{GEN}, the scope facts in (16) seem to be just another manifestation of the Event Type Principle discussed above: the event quantifier (in this case, \text{GEN}) takes the lowest scope possible with respect to quantifiers over individuals. In the literature on genericity and habituality, the obligatory wide scope of indefinites in bare habituals has often been accounted for by assuming that there is something special about \text{GEN} as compared to overt Q-adverbs. One possibility, explored in Cohen (2013), is to assume that the null generic quantifier differs from overt adverbs of quantification insofar as it is introduced by type-shifting, whence its narrow scope. More commonly, however, a more radical departure from the analysis of bare habituals in terms of \text{GEN} is entertained, whereby they are assumed to contain a scopeless non-quantificational generic operator, rather than the generic quantifier \text{GEN} (for various versions of this analysis, see Carlson, 1977; Rimell, 2004; van Geenhoven, 2004; Ferreira, 2005; Kratzer, 2008; Boneh and Doron, 2013). Sections 4 and 5 will discuss both the quantificational and the non-quantificational treatment of bare habituals in more detail. Before we get there, however, another important piece of data concerning bare habituals needs to be introduced.

3.2. Q-adverbs in habituals

Another crucial piece of data concerning habituals has to do with the fact that, in languages which have specialized habitual tense forms, these tense forms can combine with adverbs of quantification. This can be seen even in English, which does not have rich aspectual morphology, in the case of simple present habituals and, more clearly, the used to construction, as the examples below show:

(17) a. John used to smoke.
   b. *John used to smoke \textit{once/yesterday}.
   c. John used to smoke \textit{every day}.
   d. John used to \textit{always} smoke (on the phone).

The incompatibility of the used to form with adverbs like once and yesterday shows that it is a

6Note that sentences like (16) are fine in the presence of overt or implicit (contextually specified) restrictors, as the examples below demonstrate:

(i) John smokes a cigarette \{when he is nervous\}.
(ii) A: What does John do before going to sleep?
    B: He smokes a cigarette.

I won’t be concerned with such cases in this paper, simply assuming that they contain a silent always as a default adverb of quantification (Lewis, 1975), which is licensed if an overt or implicit restrictor is present. In this way, the examples above are just a sub-case of the paradigm in (15).
specialized habitual form, which cannot occur in episodic environments. On the other hand, it is perfectly compatible with adverbs of quantification, such as *always and *every day. The same is of course also true of the simple present form, which occurs not only in bare habituels, but also in sentences containing adverbs of quantification.

This fact holds in a more transparent way for languages with richer aspectual morphology that have specialized habitual marking, such as, for instance, Hindi/Urdu and Ewe, cf. the examples below. In particular, the specialized habitual morpheme -taa in Hindi/Urdu can co-occur with quantificational adverbials like *every day; in fact, the habitual aspect must be used when such adverbials are present. The same holds for the habitual marker -na in Ewe.

(18) Raam (roz /
1/ *ek baar / *kal) sigret pii-taa thaa.
R. every\_day one time yesterday cigarette drink-HAB be.PAST
‘Ram smoked/would smoke (every day/*once/*yesterday).’ (Hindi/Urdu)7

(19) Agbenyo yi-na suku ɲdi sia ɲdi.
A. go-HAB school morning that morning
‘Agbenyo goes to school every morning.’ (Ewe)8

The fact that the habitual verbal morphology is not only compatible with adverbs of quantification, but is even required in their presence, is often not taken into consideration in the analyses of the semantics of habituality. However, this fact is crucial for understanding habitual semantics, given that the habitual morphology should be attempted to be given a unified analysis across its uses in bare habituels and habituels with overt adverbs of quantification. In particular, the problem is that it is not immediately clear how to avoid double event plurality without assuming semantic inertness of habitual markers in the presence of Q-adverbs. The next section will show that this is a serious problem for a quantificational analysis of habituels.

4. Quantificational analysis of habituels

4.1. The GQ analysis

This section discusses the quantificational analysis of habituels and shows that, in combination with the GQ analysis of QPs, it fails to adequately model the semantic behavior of indefinites in bare habituels and habituels containing adverbs of quantification in a unified way.

Let us first spell out the quantificational analysis of habituels based on the silent generic quantifier GEN in somewhat more precise terms. GEN is usually assumed to be a modalized quantifier with quasi-universal force, which is designed to account for such properties of generics as, e.g., their non-accidental law-like nature and their tolerance to exceptions (cf. Dahl, 1975; Chierchia, 1995; Krifka et al., 1995; Cohen, 1999; Greenberg, 2003). Furthermore, given that the habitual is a variety of the imperfective aspect, it is plausible to assume that its semantics is introduced by a special aspectual head. On the quantificational analysis of habituels, the

7Gurmeet Kaur, p.c.
8Agbojo and Litvinov (1997).
denotation of this habitual Asp head, which is null in English, may be formalized for example along the following lines:

\[(20) \quad [\text{HAB}] = \lambda P. \lambda t. \exists e [t \subseteq \tau(e) \land \text{GENe}'[e' \subseteq e \land C(e')][P(e')]]\]

Like any imperfective head, HAB takes a property of events, quantifies over the event variable, maps the event to its run time by means of the temporal trace function \(\tau\) (cf. Krifka, 1989), and relates the event time to some reference time \(t\), such that the reference time is included in the event time (cf. Reichenbach, 1947; Klein, 1994; Giorgi and Pianesi, 1997; Kratzer, 1998). What is special about HAB in (20) as compared to other imperfective heads is that the event quantifier is generic rather than existential and that the reference time is located within the run time of the entire habitual sequence rather than any of its sub-events.\footnote{The semantics of HAB does not necessarily need to be formalized in such a way that it contains a variable over sum events, i.e., the entire habitual sequences, like in (20). Alternatively, it can also be defined by means of convex closures (cf., e.g., Boneh and Doron, 2008).}

Now, given the denotation of HAB in (20), the GQ analysis unproblematically accounts for the obligatory wide scope of indefinites in bare habituals and, thus, for the pragmatic infelicity of sentences like \textit{John smokes a cigarette}: because of the obligatory QR of QPs above the event quantifier, the only scope configuration it can derive for such sentences is \(\exists x \gg \text{GENe}\). What is more, this scope configuration gets derived without any further assumptions (such as, e.g., type-shifting in Cohen (2013)), since QPs must undergo QR above the generic quantifier, while the aspectual head HAB, which introduces the generic quantifier, cannot be QRed.

However, the GQ analysis encounters a problem with habitual sentences containing adverbs of quantification under the assumption that also such sentences contain HAB, as the data discussed in the previous section suggest. Thus, for instance, \textit{John smokes a cigarette every morning} would have the following two scope possibilities if the GQ analysis is adopted in combination with the semantics of HAB in (20):

\[(21) \quad \text{John smokes a cigarette every morning.}\]

a. \(\forall \gg \exists \gg \text{GEN}\)

b. \(\exists \gg \forall \gg \text{GEN}\)

In both cases, there is too much event plurality: both of the readings imply that a habitual series of smoking events occurs per morning, yielding an unusual short-lived habituality. Moreover, in both cases the indefinite takes scope over the generic quantifier, which should result in pragmatic infelicity, contrary to fact.

Note, finally, that this problem of double event plurality is not restricted to cases with adverbs of quantification, but also occurs when other, non-temporal quantifiers are present, as, e.g., in the example below. Again, the readings that this sentence is predicted to have imply that John habitually smokes in each of the pubs.

\[(22) \quad \text{John smokes a cigarette in every pub he walks into.}\]
Intuitively, the situation could be saved if the event quantifier was existential in such cases, i.e. if the aspectual head contributed an episodic semantics. This would mean, however, that the habitual morphology will have to have a different semantics in sentences containing adverbs of quantification and other quantifiers introducing pluralities than its semantics in bare habituals, and thus a unified analysis of habituality would not be possible.

4.2. The SE analysis

The quantificational approach to habituals faces the problem of double event plurality in combination with the SE analysis of QPs in the same way as it does in combination with the GQ analysis. In addition, however, it also fails to account for the semantic scope of indefinites in bare habituals—something that the GQ analysis has no problems with, as we have seen in the previous section. In particular, given the semantic type of QPs on the SE analysis ($\langle \langle e, \text{vt}, \text{vt} \rangle \rangle$), they can only be QRed to positions below the event quantifier, if they undergo QR at all. Yet this implies that bare habitual sentences like John smokes a cigarette will always get the scope configuration $\text{GENe} \gg \exists x$, and so should be pragmatically fine, contrary to fact. What is more, it is not clear how to derive the wide scope readings of indefinites in bare habituals at all.

The scope configuration that we would want for bare habitual sentences on the SE analysis is rather $\exists e \gg \exists x \gg \text{GENe}^\prime$, where existential quantification over sum events is contributed by the aspectual head, whereas generic quantification over sub-events is introduced in the nuclear scope of quantifiers over individuals, as proposed by Schein (1993). However, this would mean that quantificational determiners $a$, $\text{every}$, and so on, will have to be assumed to be ambiguous between two meanings that differ only with respect to the event quantifier that these determiners host in their nuclear scope, namely one with an existential and one with a generic quantifier. In addition, it would also be unclear how to motivate the fact that habitual morphology contributes existential quantification over events.

Thus, independently of the choice of the analysis of QPs, the analysis of habituality in terms of the generic quantifier does not seem to allow for a unified account of the semantic behavior of indefinites in bare habituals and in habituals containing overt quantification. The next section will consider an alternative, non-quantificational approach to habituality.

5. Non-quantificational analysis of habituals

5.1. Habituals as sum events

The semantics of habituals has a common alternative analysis to the one in terms of the generic quantifier GEN. According to it, a habitual series should be modeled as a sum of (proper) part events, rather than as quantification over events. There are various implementations of this idea in the literature (cf. Carlson, 1977; Rimell, 2004; van Geenhoven, 2004; Ferreira, 2005; Kratzer, 2008; Boneh and Doron, 2013), which differ in the details of the proposed semantics of habitual sentences. For the purposes of this paper, these details are not crucial, as the focus of the paper is on the comparison between the GQ analysis and the SE analysis with respect
to certain data concerning habituals, rather than on the semantics of habituals as such. Hence, concentrating on the core idea of the non-quantificational treatment of habituals as plural events and glossing over a lot of other details concerning their semantics, the denotation of the non-quantificational version of the habitual aspectual head HAB may be formalized in the following way, where $\sigma$ is the sum operator:

\[(23) \quad [\text{HAB}] = \lambda P. \lambda t. \exists e [t \subseteq \tau(e) \land e = \sigma e'[\text{stage}(e')(e)] \land P(e)]\]

Note that the semantics in (23) states that the individual events within the habitual series are its stages rather than just parts, that is, it employs the stage-of relation, which has been proposed in Landman (1992) to model the semantics of progressives. This reflects a common view in the literature that, being two varieties of the imperfective, the progressive and the habitual should be modeled alike (e.g., in terms of inertia futures) and that the only difference between them is that PROG selects sets of singular events, while HAB selects sets of plural events (cf. Ferreira, 2005; Deo, 2009; Altshuler, 2014). Here, the complex modal-temporal semantics of habituality will be abbreviated into the predicate $\text{stage}$.

Equipped with the semantics of HAB in (23), we can now see whether the two analyses of QPs in combination with the non-quantificational approach to habituality are able to account for the semantic behavior of indefinites in bare habituals and in habituals containing overt adverbs of quantification in a unified way.

5.2. Bare habituals

Let us start with bare habituals, using again John smokes a cigarette as a test example. Before spelling out its semantics under the GQ and SE analyses, (24) first illustrates my assumptions with respect to the basic syntactic architecture of a transitive clause and the corresponding type composition (cf., e.g., Giorgi and Pianesi, 1997; Kratzer, 1998; Alexiadou et al., 2003). Here, $i$ is the type of times, or, more precisely, time intervals.

\[(24) \quad \text{TP}_t \quad \text{T} \quad \text{AspP}_{(i,t)} \quad \text{Asp} \quad \text{VoiceP}_{(v,t)} \quad \text{DP} \quad \text{Voice'}_{(e,v_t)} \quad \text{Voice} \quad \text{VP}_{(v,t)} \quad \text{DP} \quad \text{V}_{(e,v_t)}\]

It has already been mentioned before that the aspectual head Asp relates the event time to the reference time. By contrast, the function of the tense head T is to relate the reference time and the utterance time. Accordingly, the locus of event time adverbials (such as, e.g., on Monday,
but also every morning and always) is VP/VoiceP, the locus of reference time adverbials (e.g., by tomorrow or until July 18) is AspP, while the locus of utterance time adverbials (e.g., now) is TP.

Now, given the syntax in (24), the LF of John smokes a cigarette under the GQ analysis will be as in (25), where a cigarette undergoes obligatory QR to TP for type reasons. (26) provides the interpretation we get for this LF using the non-quantificational denotation of HAB in (23) and assuming that PRES in matrix clauses denotes the deictic pronoun now referring to the time of utterance (cf., e.g., von Stechow, 2009).

\[
(25) \quad [TP \ [a \ cigarette] \ \lambda_t \ [TP \ PRES \ [AspP \ HAB \ [VoiceP \ John \ smoke \ t_1]]]]
\]

\[
(26) \quad \exists x [cigarette(x) \land \exists e [now \subseteq \tau(e) \land e = \sigma e' [stage(e')(e)] \land \text{smoke}(x)(\text{john})(e)]]
\]

This semantics adequately represents the pragmatically infelicitous reading that John smokes a cigarette has: it states that the same cigarette is smoked in the entire habitual series. Moreover, no other scope possibility is available in this case, as desired.

In fact, the situation is not much different under the SE analysis, as (27) and (28) below show: even though a cigarette can now be interpreted in situ (or be QRed to VoiceP, which would be truth-conditionally equivalent), nothing changes in its ‘wide’ scope relation with respect to the sum operator, and therefore the pragmatically odd reading obtains as the only possibility.

\[
(27) \quad [TP \ PRES \ [AspP \ HAB \ [VoiceP \ John \ smoke \ a \ cigarette]]]
\]

\[
(28) \quad \exists e [\text{now} \subseteq \tau(e) \land e = \sigma e' [\text{stage}(e')(e)] \land \exists x [\text{cigarette}(x) \land \text{smoke}(x)(\text{john})(e)]]
\]

Thus, in combination with a non-quantificational approach to habituality, both analyses of QPs are able to account for the wide scope of indefinites in bare habituals.

5.3. Overt quantification

Let us now turn to habituals containing overt adverbs of quantification, such as John smokes a cigarette every morning. As already mentioned above, I assume that phrases like every morning are (quantificational) event time adverbials, and thus are VP/VoiceP-adjuncts. Furthermore, I also assume that they are in fact PPs, whose null P head relates the time they introduce to the run time of the event, as shown below (Q-adverbs such as always are treated in the same way, being the spell-out of phrases like ‘all times’/‘every time’).

\[
(29) \quad [PP \ P \ [DP \ every \ morning]]
\]

\[\text{To make the semantic formulae below more readable, I will represent the meaning of verbs with } n \text{ syntactic arguments as } n-\text{ary relations, instead of representing their arguments as separate } \theta-\text{role conjuncts.}\]

\[\text{Indefinites don’t introduce quantification over sub-events in the nuclear scope of the existential quantifier (cf. Schein, 1993; Ferreira, 2005); thus, the denotation of a cigarette is } \lambda P. \lambda e. \exists x [\text{cigarette}(x) \land P(x)(e)]. \text{ Note that if a cigarette had a denotation along the lines of (9), it would get a narrow scope in bare habituals.}\]
The denotation of \( P \) is given by

\[
[P] = \lambda t. \lambda P. \lambda e. [P(e) \land \tau(e) \subseteq t]
\]

Now, under the GQ analysis, both \textit{a cigarette} and \textit{every morning} denote generalized quantifiers (the latter over times: \( \lambda P. \forall t [\text{morning}(t) \rightarrow P(t)] \)) and thus have to undergo QR to TP. Below the interpretation which \textit{John smokes a cigarette every morning} gets under this analysis is shown, with \textit{every morning} scoping above \textit{a cigarette}:

\[
[TP \ [\text{every morning}]_2 \ \lambda_2 \ [TP \ [\text{a cigarette}]_1 \ \lambda_1 \ [TP \ \text{PRES} \ [\text{AspP HAB} \ [\text{VoiceP John smoke t}_1 \ [\text{PP t}_2]]]\\)
\]

\[
(31) \ \forall t [\text{morning}(t) \rightarrow \exists x [\text{cigarette}(x) \land \exists e [\text{now} \subseteq \tau(e) \land e = \sigma e'[\text{stage}(e')(e)] \\
\land \text{smoke}(x)(\text{john})(e) \land \tau(e) \subseteq t]]]
\]

This semantics is problematic for several reasons. First, it states that there is a habitual series of smoking events per morning, which is not the most natural interpretation of \textit{John smokes a cigarette every morning}, if this sentence has that reading at all. Moreover, the same cigarette is smoked in all sub-events of each of such habitual sum events, which should trigger pragmatic infelicity, contrary to fact. And finally, the run time of each of these habitual events is included in the time of the respective morning, but at the same time, the run times of all of them include now (i.e., these are ongoing events), which is difficult to make sense of. Note that the inverse scope possibility (with \textit{a cigarette} scoping above \textit{every morning}) is available as well, but does not make things better.

Let us now see what happens under the SE analysis. The denotation of \textit{every morning} will be in this case as below (cf. (9)):

\[
[\text{every morning}] = \lambda P. \lambda e. [\forall t [\text{morning}(t) \rightarrow \exists e'[e' \subseteq e \land P(t)(e')]] \land \forall e'[e' \subseteq e \rightarrow \exists t [\text{morning}(t) \land P(t)(e')]]]
\]

If \textit{a cigarette} is interpreted in situ and \textit{every morning} undergoes QR to VoiceP, \textit{John smokes a cigarette every morning} gets the following interpretation:

\[
(34) \ \text{TP PRES} \ [\text{AspP HAB} \ [\text{VoiceP every morning}]_1 \ \lambda_1 \ [\text{VoiceP John smoke a cigarette [PP t}_1]]]
\]

\[
(35) \ \exists e [\text{now} \subseteq \tau(e) \land e = \sigma e'[\text{stage}(e')(e)] \\
\land \forall t [\text{morning}(t) \rightarrow \exists e'[e' \subseteq e \land \exists x [\text{cigarette}(x) \land \text{smoke}(x)(\text{john})(e') \land \tau(e') \subseteq t]] \\
\land \forall e'[e' \subseteq e \rightarrow \exists t [\text{morning}(t) \land \exists x [\text{cigarette}(x) \land \text{smoke}(x)(\text{john})(e') \land \tau(e') \subseteq t]]]
\]

The semantics above adequately captures the most natural reading of \textit{John smokes a cigarette every morning}. It states that there is an ongoing habitual series of smoking events whose sub-events distribute over mornings, and that there is a potentially different cigarette that is smoked in each of the morning smoking events. This is the pragmatically fine narrow scope reading of \textit{a cigarette}; the pragmatically infelicitous wide scope reading can be captured as well, as desired, if \textit{a cigarette} is QRed above \textit{every morning}.
Thus, this shows that only the SE analysis is able to provide an adequate semantics for habitual sentences containing overt adverbs of quantification, provided that a non-quantificational approach to habituality is adopted, while the GQ analysis is not.

6. Conclusion

This paper has shown that, if a non-quantificational approach to habituality is adopted, the GQ analysis and the SE analysis of QPs are not equally suitable for event semantics, as only the latter successfully accounts for the semantic behavior of indefinites in bare habituals and in habituals containing overt adverbs of quantification in a unified way. This is a further argument, in addition to the existing arguments from adverbs qualifying ‘ensemble’ events and mixed cumulative/distributive readings, in favor of an analysis of quantificational DPs that makes use of sub-events.

References


Acquaintance content and obviation
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Abstract. This paper is about what Ninan (2014) (following Wollheim 1980) calls the Acquaintance Inference (AI): a firsthand experience requirement imposed by several subjective expressions such as Predicates of Personal Taste (PPTs) (delicious). In general, one is entitled to calling something delicious only upon having tried it. This requirement can be lifted, disappearing in scope of elements that we will call obviators. The paper investigates the patterns of AI obviation for PPTs and similar constructions (e.g., psych predicates and subjective attitudes). We show that the cross-constructional variation in when acquaintance requirements can be obviated presents challenges for previous accounts of the AI (Pearson 2013, Ninan 2014). In place of these, we argue for the existence of two kinds of acquaintance content: (i) that of bare PPTs; and (ii) that of psych predicates, subjective attitudes and overt experiencer PPTs. For (i), we propose that the AI arises from an evidential restriction that is dependent on a parameter of interpretation which obviators update. For (ii), we argue that the AI is a classic presupposition. We model both (i) and (ii) using von Fintel and Gillies’s (2010) framework for directness and thus connect two strands of research: that on PPTs and that on epistemic modals. Both phenomena are sensitive to a broad direct-indirect distinction, and analyzing them along similar lines can help shed light on how natural language conceptualizes evidence in general.

Keywords: evidentiality, firsthand experience, knowledge, predicates of personal taste, subjectivity

— Cleveland. It’s a beautiful city.
— Yes?
— Yeah.
— It’s got a big, beautiful lake. You’ll love it there.
— Have you been there?
— No, no.

Stranger than paradise
JIM JARMUSH

1. Introduction

This paper is devoted to what Ninan (2014) (following Wollheim 1980) calls the Acquaintance Inference (AI): a firsthand experience requirement imposed by several subjective expressions such as Predicates of Personal Taste (PPTs) (tasty, fun), psych predicates (look, sound) and subjective attitudes (find, consider); see also (Stephenson 2007, Anand 2009, Pearson 2013, Klecha 2014, Ninan 2014, Kennedy and Willer 2016, Bylinina 2017). Asserting sentences in (1), the speaker is committed to having a relevant firsthand experience with the object in

1We would like to thank Cleo Condoravdi, Boris Harizanov, Dan Lassiter, Ben Mericli, Deniz Özyildiz, Igor Yanovich, audiences in Konstanz, at SuB 22 and at UChicago workshop “Subjectivity in language and thought”, and Collaborative Research Center 833 “Construction of meaning” for financial support.

2For the purposes of this paper, we do not distinguish between predicates of taste proper and e.g. aesthetic predicates such as beautiful, as both types of predicates have the AI.
question: gustatory (1a), auditory (1b), or visual (1c).

(1) a. PPT
The cake was delicious, #but I never tasted it.
b. PSYCH PREDICATE
The piano sounded out of tune, #but I never heard it.
c. SUBJECTIVE ATTITUDE
I consider the dress blue and black, #but I never seen it.

The AI also survives under negation:

(2) a. PPT
The cake wasn’t delicious, #but I never tasted it.
b. PSYCH PREDICATE
The piano didn’t sound out of tune, #but I never heard it.
c. SUBJECTIVE ATTITUDE
I don’t consider the dress blue and black, #but I never seen it.

At the same time, even though the AI cannot be explicitly denied or negated, it may disappear in the scope what we will call obviators, exemplified with epistemic might in (3) below:

(3) a. PPT
✓The cake was might have been delicious, though I never tasted it.
b. PSYCH PREDICATE
✓The piano might have sounded out of tune, though I’ve never heard it.
c. SUBJECTIVE ATTITUDE
✓I might have considered the dress blue and black, though I’ve never seen it.

The central puzzle of this paper is the contrast in (3) and (1): Why is obviation possible while explicit denial is not? A larger issue that is related to the epistemology of personal taste but that we are not going to discuss is why subjective expressions have the AI in the first place (see Bylinina 2017, Muñoz 2017) for ontological explanations. We concentrate instead on the status of the AI and the cross-constructional variation in AI obviation that poses challenges for previous accounts of the AI. Our verdict is that there are in fact two types of acquaintance content. With ‘bare’ PPTs (i.e., ones unmodified by to/for phrases), we propose that the AI arises from an evidential restriction that is dependent on a parameter of evaluation that obviators update. With psych predicates, subjective attitudes and overt taster PPTs (tasty for me), we argue that the AI is a classic presupposition. Section 2 introduces the empirical landscape. Section 3 discusses previous approaches to the AI (Ninan 2014, Pearson 2013) and their shortcomings. Section 4 presents our direct proposal couched in terms of von Fintel and Gillies’s (2010) kernels. Section 5 concludes.
2. Empirical landscape

This section discusses what types of situations can constitute direct experience with different PPTs, categorizes contexts in which the AI disappears and talks about the patterns of AI obvi-ation with different subjective expressions.

2.1. Directness

Before we proceed, a discussion of issues related to the nature of firsthand experience is in order. First of all, while some PPTs, such as tasty (1a) or delicious, dictate the type of experience, some others, such as gorgeous (4) or beautiful, exhibit more freedom, with sensory modality depending on the specific stimulus:

(4) My blindfolded dance last night was gorgeous. I couldn’t see what I was doing, but I could feel my body in each position.

What exactly counts as firsthand depends on a situation. First, the experience does not have to be complete: in fact, even smaller samples entitle the experiencer to a judgment about the stimulus (5a), which is in contrast with no experience at all (5b):

(5) a. INCOMPLETE EXPERIENCE:
   ✓ I only watched \{ the trailer / the first five minutes \}. This movie is boring.
   b. NO EXPERIENCE:
      # The new Allen movie is boring. I haven’t watched it, but they are all the same.

Examples like (5b) above should not be confused with cases of type-token ambiguity (6):

(6) a. TYPE
   Massaman curry is delicious, ✓ I’ve tried it before at another restaurant.
   b. TOKEN
   This Massaman curry is delicious, # but I haven’t tried it yet.

Second, the presence of an AI does not always indicate immediate perception. For example, I am entitled to call the San Juans beautiful even if I have only seen a picture of the range. However, the boundary between firsthand and non-firsthand is not clear-cut. While I am not entitled to calling the curry tasty upon looking at a picture or reading a recipe, I may well be upon seeing other patrons ordering it or reading reviews, and judgments about those latter cases vary.

Finally, world knowledge needs to be factored in. Different tasters will have different thresholds for what can be classified as firsthand. A professional photographer looking at a histogram or a professional musician looking at a string of notes would be entitled to make an aesthetic judgment, while a layperson would not.
The above issues related to the nature of firsthand experience are not unique to PPTs alone and arise with other natural language expressions dealing with evidence, including evidentials (REFS: faller, mccready) and epistemic modals (von Fintel and Gillies 2010). For example, different languages with grammatical evidentiality may conceptualize the same situation, such as inference from observable results, in different ways (Korotkova 2016). While a thorough discussion is beyond the scope of this paper, the central observation still stands: PPTs encode a type of firsthand experience, however construed, and our direct knowledge proposal in Section 4 captures this intuition.

2.2. Obviators

As shown in Section 1, the AI is not always present and disappears in the scope of epistemic might (3). The list of what we call obviators is in fact broader and includes epistemic must (7a), epistemic adverbs (7b), futurate operators (7c) and predicates of clarity (7d) (cf. also Pearson 2013, Klecha 2014, Ninan 2014).

(7) The cake ...................... delicious, but I never tasted it.
   a. EPISTEMIC MODAL AUXILIARIES:
      ✔must/might have been
   b. EPISTEMIC ADVERBS:
      ✔probably/possibly/maybe was
   c. FUTURATE OPERATORS:
      ✔will/is going to be
   d. PREDICATES OF EVIDENCE/CLARITY:
      ✔obviously/certainly/apparently was

Klecha (2014) argues that obviation diagnoses the presence of a modal operator. We propose instead that obviators convey indirectness of some sort (see also Winans 2016 on will) and thus do not commit ourselves to a theory where all obviators belong to the same semantic category (pace Klecha 2014). Fittingly, grammatical markers of indirect evidentiality also follow the pattern, as illustrated with Turkish mış in (8) (see Şener 2011 on evidentiality in Turkish):

(8) Turkish (Turkic: Turkey)
   a. BARE FORM:
      #Durian güzel, ama hiç dene-me-di-m.
      durian good, but ever try-NEG-PST-1SG
      Intended: ‘Durian is good, but I’ve never tried it’.
   b. EVIDENTIAL mış:
      ✔Durian güzel-miş, ama hiç dene-me-di-m.
      durian good-IND, but ever try-NEG-PST-1SG
      ‘Durian is good, I hear/infer, but I’ve never tried it’.
Additionally, hedges (9) and markers of emphatic certainty such as I know (10) lift the AI:

(9) HEDGES:
    I assume/suppose/think that the cake was delicious, but I haven’t tasted it.

(10) a. BARE FORM:
    #Climbing the Half Dome is amazing. We should do it.
    b. I KNOW:
    ✓I know that climbing the Half Dome is amazing. We should do it.

ONE SENTENCE ABOUT I KNOW & REF
In the rest of the paper, we restrict our attention to clause-mate obviators to avoid potential confounds related to the syntax of parenthesis.

2.3. Overt tasters: PPTs and otherwise

So far, we have been talking only about “bare” uses of PPTs, ones where the linguistic form does not make the relevant taster explicit. However, PPTs also admit overt tasters introduced by prepositions to and for in English, such as in tasty to me or to Hobbes (see Bylinina 2017 on cross-linguistic parallels). As (11) indicates, obviation patterns with covert and overt tasters are distinct:

(11) OVERT TASTER PPS:
    The cake . . . . . . . . . . . . . . . . . . . . . . delicious to me, but I never tasted it.
    a. EPISTEMIC MODAL AUXILIARIES:
      #must/#might have been
    b. EPISTEMIC ADVERBS:
      #probably/#possibly/#maybe was
    c. FUTURATE OPERATORS:
      ✓will/is going to be
    d. PREDICATES OF EVIDENCE/CLARITY:
      #obviously/#certainly/#apparently was

The AI of bare PPTs is lifted in the scope of all operators from (11). However, overt tasters impose much stricter conditions on obviation. Under many accounts of PPTs (see Coppock 2018 for a recent discussion), the possibility of having an explicit taster expressed via a PP is often treated as an argument for making PPTs dyadic predicates, with either an overt taster (via a PP with a semantically inert P) or a covert pronominal-like taster supplied for bare uses (a.o. Stephenson 2007, Stojanovic 2007, Pearson 2013, Bylinina 2017). Such theories would thus predict that overt and covert tasters should behave the same with respect to obviation. As (11)

3We are not committed to a view such that tasters are always represented in the linguistic structure and will use the term covert taster descriptively to refer to a situation when the taster is not present in the surface structure.
shows, this prediction is not borne out, which can be used as an argument against theories that treat overt and bare uses on a par.

In introduction, we have shown that other subjective expressions, namely psych predicates and subjective attitudes, also have an AI (1b, 1c) that disappears in the scope of might (3b, 3c). The overall obviation pattern with those expressions resembles that of PPTs vis-à-vis the presence of an overt experiencer. For psych predicates that do not have an overt perceiver, the AI can be lifted by obviators from section 2.2, as shown in (12) below:

(12) **PSYCH PREDICATE WITHOUT AN EXPERIENCER:**

The cake ................. delicious, but I never tasted it.

a. **EPISTEMIC MODAL AUXILIARIES:**
   ✔ must/might have looked
b. **EPISTEMIC ADVERBS:**
   ✔ probably/possibly/maybe looked
c. **FUTURATE OPERATORS:**
   ✔ will/is going to look
d. **PREDICATES OF EVIDENCE/CLARITY:**
   ✔ obviously/certainly/apparently looked

For cases where the experiencer is overtly present in the linguistic form, the obviation pattern is constrained in the same way it is with overt taster PPTs (11), as illustrated in (13) for psych predicates and in (14) for subjective attitudes:

(13) **PSYCH PREDICATE WITH AN EXPERIENCER:**

The cake ................. delicious to me, but I never tasted it.

a. **EPISTEMIC MODAL AUXILIARIES:**
   #must/#might have looked
b. **EPISTEMIC ADVERBS:**
   #probably/#possibly/#maybe looked
c. **FUTURATE OPERATORS:**
   ✔ will/is going to look
d. **PREDICATES OF EVIDENCE/CLARITY:**
   #obviously/#certainly/#apparently looked

(14) **SUBJECTIVE ATTITUDE:**

I ................. the cake delicious, but I never tasted it.

a. **EPISTEMIC MODAL AUXILIARIES:**
   #must/#might have found
b. **EPISTEMIC ADVERBS:**
   #probably/#possibly/#maybe found
c. **FUTURATE OPERATORS:**
Examples (11), (13) and (14) demonstrate that expressions where the experiencer whose first-hand experience is tracked by the AI is overt all pattern together and allow obviation only in a limited set of contexts: under futurate markers will and going to, and under epistemic might. We suggest that such cases of obviation are simply instantiations of local accommodation in the scope of a future (or counterfactual) operator, which does not obviate the AI per se as much as temporally displaces it. Indeed, if one attempts to counter that displaced AI, contradiction results:

(15) a. #Even if I hadn’t tried the cake, I might have found it delicious.
   b. #Even though I am never going to ever try it, the cake is going to be delicious to me.

Bare PPTs and psych predicates, on the other hand, are more liberal. These facts are summarized in table 1 below.

```
<table>
<thead>
<tr>
<th>Obviators</th>
<th>Covert Experiencers</th>
<th>Overt Experiencers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PPT</td>
<td>Psych predicates</td>
</tr>
<tr>
<td>must</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>might</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>epistemic adverbs</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>predicates of clarity</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>futurate markers</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>
```

Table 1: Obviation facts

The next section is about previous approaches to the AI obviation. We will show that they are not fine-grained enough to account for the discrepancy in behavior between overt and covert tasters and that not all of them actually explain the main puzzle, namely the possibility of obviation in the first place. In section 4, we present our account and use obviation as a tool to adjudicate between different approaches to PPTs.

3. Previous approaches


Ninan (2014) offers a pragmatic account according to which the AI arises due to an epistemologically grounded norm of assertion.4

---

4As Ninan himself notes, the exact inventory of the norms of assertions is actively debated in epistemology and philosophy of language (Williamson 2000, Lackey 2007, Weiner 2005), and it is not essential for his analysis whether assertions require knowledge rather than, say, justified belief.
In order to know the truth of \( x \) is tasty, the speaker must have prior experience with \( x \).

Asserting unmarked sentences typically assumes such knowledge, which results in the infelicity of explicit denials, as illustrated in (17, repeated from 1a):

(17) \#The cake was delicious, but I never tasted it.

If one were to assert that the cake is tasty, one could do it only in case they have tried it, as per (16). However, the second conjunct states that the speaker has no experience with the cake, which yields a clash. Under this approach, (17) is odd not because of the semantics of PPTs but due to a conflict between what is said and what the speech act of assertion requires. Such an explanation is along the lines of classic traditional popular widespread accounts of Moore’s paradox (REFS). It predicts that, just like with Moore-paradoxical sentences (Yalcin 2007), the oddness would go away in attitude reports, an environment that demarcates the divide between semantics and pragmatics. As the non-contradictory (18) shows, the predictions is borne out (as we discuss in section 4, Ninan’s is not the only way to account for the felicity of (18)):

(18) Jay thought that the cake was delicious and that he has never tasted it.

Ninan (2014) correctly predicts that negated sentences with PPTs still carry an AI because linguistic negation does not affect knowledge requirements. Obviation, on the other hand, is possible because marked (e.g. modalized) propositions are not subject to the convention in (16). The pragmatic account therefore successfully explains the Puzzle. However, there are at least two challenges faced by this type of proposal.

The first problem is the cross-constructional variation in AI obviation. As shown in section 2.3, obviation is limited with overt tasters, the relevant contrast repeated in (19) below:

(19) a. COVERT TASTER:  
✓The San Juans must be beautiful, but I have never seen them.  
b. OVERT TASTER:  
#The San Juans must be beautiful to me, but I have never seen them.

Ninan does not discuss overt tasters, but it seems reasonable to assume that the convention in (16) would be insensitive to the linguistic form of the taster and apply to sentences with overt taster PPs just as well. It is then expected that obviation patterns with overt and covert tasters would be the same, contrary to fact.

The second problem for Ninan are the so-called non-autocentric uses (Lasersohn 2005). Generally, PPTs describe the speaker’s tastes. However, PPTs can be also used to talk about third party’s judgments (cf. Stephenson 2007):

62 Pranav Anand and Natasha Korotkova
Rotting flesh is delicious (to a vulture). (adapted from Egan et al. 2005)

Non-autocentric readings also have an AI (21a) that is subject to obviation (21b). Ninan’s (2014) pragmatic approach rooted in the speaker’s knowledge does not predict it.

EXOCENTRIC AI

a. Hobbes’s new food is tasty, #but no cat has ever tried it yet.

b. \(\checkmark\) Hobbes’s new food \{ must be / obviously is / will be \} tasty, but no cat has ever tried it yet.

Based on the data from overt tasters and the non-autocentric AI, we conclude that Ninan’s proposal undergenerates and does not fully account for AI obviation.


A different approach to the AI is due to Pearson (2013). The core components of her proposal relevant to our discussion here are an experience presupposition and first-person genericity (see Anand 2009; and especially Moltmann 2010, 2012). The formal details (in a simplified version) are laid out below.

\[
\llbracket \text{tasty-to} \rrbracket^{c,i} = \lambda x \lambda o : x \text{ has tried } o \text{ in } \text{WORLD}(i). 1 \text{ iff } o \text{ is tasty to } x \text{ in } \text{WORLD}(i)
\]

The presupposition in (22) ensures that statements with PPTs are only felicitous when the taster \(x\) has firsthand experience with the stimulus \(o\). It cannot be cancelled, which accounts for the infelicity of explicit denials (3), and projects out of negation, which explains why even negated PPTs trigger an AI (2).

Pearson argues that PPTs display the signature behavior of individual-level predicates (e.g. tall; Carlson 1980) such as universal interpretations with bare plurals and infelicity in existential constructions. She further adopts Chierchia’s (1995) analysis of individual-level predicates, wherein all such predicates are inherently generic, and argues that PPTs always come with \(\text{GEN}^{5}\):

\[
\begin{align*}
\text{a.} & \quad \text{This is tasty.} \\
\text{b.} & \quad [\text{This}_{i} [\text{GEN } t_{i} \text{ is tasty }]
\end{align*}
\]

\(\text{GEN}\) binds the taster argument \(x\) and is restricted by quantificational domain restriction \(\text{Dom}\):

\(^{5}\)Czypionka and Lauer (2017) argue against Chierchia’s (1995) proposal, but the generity of PPTs can be, and has been, formalized in a number of other ways, see (Anand 2009, Moltmann 2010, 2012), so this specific worry is not important for our criticism of Pearson’s approach.
(24) $\forall \langle x, w' \rangle : x \in \text{Dom} \ [\text{the cake is tasty-to } x \text{ in } w']$

The experience presupposition projects universally yielding the following:

(25) $\forall \langle x, w' \rangle : x \in \text{Dom} \ [x \text{ has tried } o \text{ in } w']$

Unlike Ninan (2014), Pearson can account for the non-autocentric AI. This is achieved in the following way. By default, the speaker is included in $\text{Dom}$, which reflects the intuition that most uses of PPTs are about the speaker’s tastes. However, there are cases when the speaker’s tastes are irrelevant. This is precisely the situation with classic non-autocentric uses of PPTs (20), where the speaker is not the “target audience” and thus not in $\text{Dom}$ (Pearson does not specify when exactly the speaker can be irrelevant, which, as we will see below, is problematic). However, the presence of an AI does not depend on who the taster is because the presupposition is generic. This explains that even non-autocentric uses will have an AI (21a) that is no different from an autocentric one.

Pearson attempts to solve the Puzzle by using reasoning from indirectness (her discussion is based on $\text{must}$, but can easily be extrapolated to other obviators from section 2.2). According to von Fintel and Gillies (2010), Lassiter (2016), $\text{must}$ signals the lack of direct evidence for its predjacent. In case of statements with PPTs, it would mean that the speaker (in default cases) has no firsthand evidence for $o$’s tastiness. And if the speaker hasn’t tried $o$, the speaker will be irrelevant and thus not in $\text{Dom}$. When the speaker is not in $\text{Dom}$, the generic presupposition does not apply to them and obviation is felicitous.

This type of proposal explains obviation, but, as pointed out by Ninan (2014), it overgenerates. Reasoning from indirectness should carry over to explicit denials. If the speaker can be irrelevant with $\text{must}$, which indicates that they have no firsthand experience, then by the same token the speaker should be irrelevant with explicit denials. However, obviation is allowed, while continuations in (1). So Pearson does not actually solve the Puzzle.

Her proposal faces further problems. It predicts that the speaker, when not in $\text{Dom}$, is necessarily irrelevant and is not committing to a judgment on $o$ if/when they do try it. The prediction is false, since an explicit continuation as in (26) leads to contradiction.

(26) Just look at it! The cake { is / must be } delicious, #but I am going to find it disgusting.

Finally, by connecting the AI to genericity, Pearson’s (2013) analysis predicts that the verifying instance-hood of dispositional generics like the example in (27a) should pattern like PPTs. However, the obviation with these generics is even more constrained (27b). That is, the existence of a verifying smiling instance in (27a) does not seem to be obviatable by operators such as obviously:
(27)  a. Flavio smiles.
    b. Even though your son hasn’t smiled yet, based on his age, he obviously { #does /
    ✔ can }.

We conclude that Pearson’s proposal does not account for AI obviation. In the next section, we
present an account that does.

4. A direct proposal

We take the acquaintance content of PPTs to comment on direct evidential grounds for a propo-
sition and model the AI following the account of directness proposed by von Fintel and Gillies
(2010) (vF&G) for epistemic must.

4.1. Framework for directness

don Fintel and Gillies (2010), and later Lassiter (2016), argue that epistemic must is sensitive
to evidential grounds for a proposition. Their point of departure is as follows. Statements with
epistemic must are infelicitous if the predjacent \( p \) was learned via immediate perception and
felicitous if \( p \) was inferred, as the minimal pair in (28) and (29) illustrates:

(28) Looking out of the window and seeing a downpour: PERCEPTION
    a. ✔It is raining.
    b. #It must be raining.

(29) Seeing people with wet umbrellas: INFERENC
    a. #It is raining.
    b. ✔It must be raining.

To account for the contrast between (28) and (29), vF&G propose that must can only target
information that is not known directly. They assume an epistemological framework in which
knowledge comes in (at least) two flavors: propositions that are known directly, e.g. via imme-
diate perception, and propositions that are are known but indirectly, e.g. via reasoning. This is
formalized using kernels (30):

(30) Kernels
    a. A kernel \( K \) is a set of propositions that encode direct knowledge
    b. \( K \) directly settles (whether) \( p \) iff \( \exists q \in K \ [ q \subseteq p \lor q \subseteq \neg p ] \)
    c. The proposition \( \cap K \) is a vanilla epistemic modal base: the set worlds compatible
       with what is known directly and indirectly

Importantly, \( \cap K \) may entail \( p \) without \( K \) directly settling whether \( p \). \( K \) directly settles whether
it is raining in (28) but not in (29). Under the proposed analysis, must presupposes a lack of
direct settlement (i.e., indirect evidence); this then accounts for the contrast in (28) and (29):

\[(31) \text{\textbf{MUST}}\]

\[\text{a. } \left[ \text{must } p \right]^{c,i} \text{ is defined only if } K \text{ does not directly settle } \left[ p \right]^{c}\]

\[\text{b. If defined, } \left[ \text{must } p \right]^{c,i} = 1 \text{ iff } \bigcap K \subseteq \left[ p \right]^{c}\]

Unlike what (28,29) would suggest, the licensing of must (and hence the notion of direct evidence) is hardly straightforward. For one thing, relative to context, it may even admit immediate perception. Professional epistemologists—trained to be skeptical of their own eyes—may use must even when they visually observe rain, and such cases have been used in the recent literature (Giannakidou and Mari 2016, Goodhue 2017) to argue that must tracks the lack of knowledge rather than the lack of directness. We believe that vF&G’s observation about the indirectness of must can be reconciled with recent criticisms once more research is done on the link between types of knowledge and evidence for claims. For the purposes of this paper, we maintain that must carries an evidential signal which can be formalized using kernels.

4.2. PPTs, kernels and obviation

The analysis advocated by vF&G puts epistemic modals in a loose category of linguistic expressions that deal with the divide between direct and indirect evidence. Grammatical markers of evidentiality come to mind first (see e.g. Bybee 1985, Izvorski 1997, Matthewson et al. 2007 on the relation between epistemic modality and evidentiality), but the overall number of such expressions is larger. And if there are distinct phenomena such that their felicity conditions depend on the presence or absence of firsthand experience, then it is only natural to analyze them along similar lines. In this section we do precisely that.

We propose that the AI of PPTs and other subjective expressions is another instance of kernel-dependence. In doing so, we do not commit ourselves to a worldview such that all expressions that are “about” evidence must belong to the same semantic category. Instead, we use the concept of (in)directness to link those expressions and, as we will show, specific formal details vary even within PPTs. We use kernels as a convenient formal object that may be manipulated, with the above caveats that they may be incomplete or misguided.

We will treat kernels as interpretative coordinates, much like information states for Yalcin (2007) (cf. also Hacquard 2006). We also use the judge parameter, first proposed by Lasersohn (2005), to determine who the taster is in each particular situation. Indices of evaluation are thus minimally 4-tuples: \(\text{\langle world, time, kernel, judge \rangle}\). Note that our goal is to give a precise implementation for the AI and that we are largely agnostic about other aspects of the semantics of PPTs. The judges are here for purely representational reasons. It is easy to reformulate our insights within other theories (see MacFarlane 2014, Zakkou 2015, Lasersohn 2017, Coppock 2018 for an overview). Finally, we assume that evaluation of a proposition for truth conventionally sets the kernel to that of the speaker’s or non-autocentric judge’s directly experienced knowledge.
Our semantics for PPTs is given in (32):

(32) a. \[
    \left[ \text{tasty} \right]^{c, (w, t, K, j)} =
    \lambda o : K \text{ directly settles whether } o \text{ is tasty for } j \text{ in } w \text{ at } t \iff o \text{ is tasty for } j \text{ in } w \text{ at } t
\]

b. \( K \) directly settles whether \( p \) iff \( \exists q \in K \left[ q \subseteq p \lor q \subseteq \neg p \right] \)

Applied to a sentence with a PPT (33a), such semantics yields (33b):

(33) a. This cake is delicious.

b. \( \left[ \text{The cake is delicious} \right]^{c, (w, t, K, j)} = \lambda o : K \text{ directly settles whether cake is delicious for } j \text{ in } w \text{ at } t \iff \text{cake is delicious for } j \text{ in } w \text{ at } t \)

The semantics in (32) and (33) says nothing about the judge having firsthand experience with the stimulus. We propose that the AI arises because, ontologically, the only way to directly settle whether something is tasty is for the relevant taster to try it. An unmodified sentence with a PPT will be undefined otherwise. Because we model the direct settlement requirement as a presupposition, the AI is predicted to be present in both affirmative and negative sentences (34, repeated from 2a):

(34) The cake wasn’t delicious, #but I never tasted it.

Non-autocentric uses of PPTs are unproblematic under this view. The judge does not have to be the speaker even in root clauses, and given that \( K \) and \( j \) are not semantically connected, the presence of an AI will not depend on who the judge is.

The explanation of the Puzzle is done in two steps. The first step is to exclude explicit denials (35, repeated from 1a):

(35) The cake was delicious, #but I never tasted it.

Per (32), PPTs like delicious are only defined if \( K \) directly settles whether the stimulus is tasty to the judge. And this can be settled just in case the judge has tried the stimulus. The second conjunct explicitly states that the judge hasn’t tried the cake. The first conjunct will not be defined whenever the second one is true, which correctly predicts that explicit denials would be infelicitous.

The second step is to account for obviation, illustrated in (36, repeated from 7a):

(36) ✔The cake must have been delicious, but I never tasted it.

We propose that the contrast between obviation and explicit denials stems from grammatical facts about obviators, an approach that allows us to avoid problems faced by Ninan (2014) and Pearson (2013). Specifically, we propose that epistemic modals and other markers of indirect-
ness update the kernel (like attitudes for Yalcin (2007)). The mechanics is exemplified in (37) below with epistemic must.

We propose that must eliminates the direct-indirect distinction in its scope by overwriting $K$ with $\{\cap K\}$ (37a), which leads to a requirement that the relevant information state is decided on the prejacent (37b).

(37)  

a. $[\text{must } p]^{c,\{w,t,K,j\}} = [\text{must }]^{c,\{w,t,K,j\}}(\lambda p^{c,\{w,t,\cap K,j\}})$

b. Given the semantics for PPTs:

$[\text{must \{the curry is tasty\} }]^{c,\{w,t,K,j\}}$ is defined iff $\{\cap K\}$ directly settles whether the curry is tasty

c. vF&G’s semantics for must:

$[\text{must }]^{c,\{w,t,K,j\}}$

$= \lambda p : K$ does not directly settle whether $p$. $\cap K \subseteq p$

Per (37b), the directness requirement of PPTs disappears under must: it is only required that the prejacent is known, but it does not matter whether it is known directly or indirectly. Therefore, continuations that explicitly state that the judge has no firsthand experience, as in (36), are felicitous. (must’s general exclusion of direct knowledge in (37c) accounts for the fact that is odd to utter (38)):

(38) # I tried the cake. It must be tasty.

We propose that other obviators follow the scheme in (37), but leave precise details for future research.6

4.3. Overt tasters

As we have shown in section 2.3, obviation is subject to cross-constructional variation. When the taster is covert, which is the case for ‘bare’ uses of PPTs and psych predicates, obviation is allowed with different markers of indirectness such as epistemic modal auxiliaries, epistemic adverbs, futurate operators and predicates of clarity (section 2.2). However, obviation is highly restricted with overt tasters: PPTs with to phrases, psych predicates, and subjective attitudes. The contrast is illustrated in (39) and (40, repeated from 19):

(39) PRESENCE OF AN AI

a. The San Juans are beautiful, #but I have never seen them. COVERT

b. The San Juans are beautiful to me, #but I have never seen them. OVERT

6In addition, while we follow vF&G in treating must as a marker of epistemic necessity, this aspect of their analysis is not crucial for us. The strength of must is a matter of a debate (see discussion in Lassiter 2016) and one can easily recast our approach to obviation within theories that treat must as weak, e.g. along the lines of classic Kratzerian semantics (Kratzer 1981, 1991).
The facts in (39) and (40) present challenges for the accounts of the AI that do not differentiate between two types of acquaintance content. Such cases or overt tasters in general are not discussed explicitly by either Ninan (2014) or Pearson (2013), but based on the overall shape of their respective theories, we think that neither of them predicts our data.\footnote{As discussed in section 3.2, Pearson’s (2013) account of obviation relies crucially on the presence of a generic operator and on the possibility of the taster to be excluded from its quantificational domain. With overt taster PPs in mind, she briefly mentions that not all uses of PPTs may be generic, but a further elaboration would be needed to see how this approach fares with respect to the cross-constructional variation in AI obviation.}

Furthermore, the new data from obviation allow us to formulate a constraint on theories of PPTs (without taking a stand as to which one is correct). The existence of overt tasters is often taken as evidence that PPTs always take a taster argument (a.o. Stephenson 2007, Stojanovic 2007, Pearson 2013) whose semantics is the same in both covert and overt realizations. Such theories do not predict the contrast in (39) and (40). On the other hand, theories with a disjoint treatment of bare vs. overt uses (cf. Lasersohn 2005, MacFarlane 2014) do not face this problem. Therefore, obviation facts support such treatment.

We extend our analysis of ‘bare’ uses to overt tasters DPs and propose that overt judges depend on the DP’s doxastic kernel (41):

\[ \text{tasty to } \alpha^{c,i} = \lambda o : \text{the kernel of } \left[ \alpha^{c,i} \right] \text{ in } w \text{ at } t \text{ directly settles whether } o \text{ is tasty to } \left[ \alpha^{c,i} \right] \text{ in } w \text{ at } t. \ 1 \text{ iff } o \text{ is tasty to } \left[ \alpha^{c,i} \right] \text{ in } w \text{ at } t. \]

For non-obviated cases, the semantics (42) is the same as with ‘bare’ uses in (33) (modulo the judge) and the AI arises because of the direct settlement requirement:

\( a. \) The curry is delicious to me.

\( b. \) \[ \left[ \text{The curry is delicious to me} \right]^{c,(w,t,K,j)} = \lambda o : K \text{ directly settles whether curry is delicious to } speaker(c) \text{ in } w \text{ at } t. \ 1 \text{ iff } cake \text{ is delicious to } speaker(c) \text{ in } w \text{ at } t \]

With obviators, things differ. Obviators update the \( K \) coordinate, but overt tasters ignore that coordinate. The presupposition triggered by the PPT is thus unaffected, and it projects. This mean that when the overt taster is the speaker, contradiction (or a sense of forgetfulness, at least) will typically arise, as in (43):\footnote{This is exactly the behavior that the presuppositional analysis in Pearson (2013) predicts for ‘bare’ PPTs. While Ninan (2014) rightly criticizes it for ‘bare’ PPTs, it makes the right predictions for overt forms.}
must [the curry is delicious to me] is defined if

a. [imposed by must] iff K does not directly settle whether the curry is delicious to me

b. [imposed by PPT] iff the speaker’s kernel directly settles whether the curry is delicious to me

Though we have only provided a semantics for PPTs here, we assume other subjective expressions behave similarly: the AI stems from a presupposition sensitive to a kernel-coordinate, which obviators overwrite; in turn, overt tasters pick out a distinct kernel, leading to a classic presupposition.

5. Conclusions

This paper explores the nature of the Acquaintance Inference, a firsthand experience requirement present with several subjective expressions across affirmative and negated sentences. The AI cannot be explicitly denied, which indicates that it is not an implicature, but can be sometimes lifted, a phenomenon we call obviation. We formulate the novel empirical generalization that covert and overt experiencers behave differently across obviation contexts.

Our analysis is rooted in research on (in)directness. We argue that PPTs and other AI-triggering subjective expressions comment on the evidential grounds for a proposition. We show that obviation is possible with linguistic expressions that convey indirectness, including epistemic modals and futurate markers in English as well grammatical markers of indirect evidentiality in languages like Turkish. A consequence of this approach is that obviation should be treated as a diagnostic of indirectness, not modality (pace Klecha 2014).

We further argue that obviators collapse the distinction between direct and indirect knowledge, which in turn makes it possible to use a PPT in their scope even in situations when the taster has no prior experience with the stimulus. To formalize our claims, we use von Fintel and Gillies’s (2010) kernels. Beyond the formal niceties, the broader goal of the paper is to highlight a connection between PPTs and epistemic modals, and hence to shed light on how natural language conceptualizes evidence in general. In future work, we hope to push this idea further by investigating the interaction of subjective expressions with bona fide markers of direct evidentiality and their relation to other expressions with similar restrictions, such English copy-raising constructions (Asudeh and Toivonen 2012, Rett, Hyams, and Winans 2013) and expressions dealing with internal states across languages, e.g. egophoricity (Coppock and Wechsler 2018).

We also hope to examine the properties of obviators more closely. Though we consider clause-mate obviators, our semantics can extend to attitude verbs to predict that they, too, act as obviators (cf. Yalcin 2007), which accounts for (18). But, by treating obviation as elimination of the direct-indirect distinction, we predict that (44a) and (44b) should be synonymous.
That they are not suggests that more must be said about how indirectness and obviation interact, a task we leave to future work.

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No explanation for the historical present: Temporal sequencing and discourse
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Abstract. Discourses in the historical (or narrative) use of the simple present in English prohibit backshifting, though they allow forward sequencing. Unlike both reference time theories and discourse coherence theories of these temporal inferences, we propose that backshifting has a different source from narrative progression. In particular, we argue that backshifting arises through anaphora to a salient event in the preceding discourse.

Keywords: tense, discourse coherence, coherence relations, perspective.

While the present tense in English is typically described as indexical to the time of utterance, it has long been acknowledged that it can be used “historically” to describe situations that have already taken place or “narratively” for those that are simply imagined. This historical present (or, HP) is often described as more vivid or dramatic than the simple past, enabling the speaker to “recall[] or recount[] the past as vividly as if it were present” (Palmer, 1965: 39), as if the events were unfolding before her eyes (see also Leech 1971: 6–7, Close 1981: 106).

(1) Mr. Tulkinghorn takes out his papers, asks permission to place them on a golden talisman of a table at my Lady’s elbow, puts on his spectacles, and begins to read by the light of a shaded lamp. (Dickens, Bleak House)

Vividness aside, here we discuss a novel contrast between the HP and simple past that concerns how events are temporally ordered in simple multi-sentence discourses. The simple past in English evinces a famous ambiguity: its temporal interpretation can advance in tandem with linear order (2a) or be backshifted (2b).

(2) a. Narrative progression
The administration fired Mike. He lost his house. \( e_1 < e_2 \)
b. Backshifting
The administration fired Mike. He met with the ambassador. \( e_1 > e_2 \)

In contrast, while the HP allows narrative progression (3a), it prohibits backshifting (3b), a fact which, to our knowledge, has not previously been observed.

(3) a. The administration fires Mike. He loses his house. \( e_1 < e_2 \)
b. The administration fires Mike. He meets with the ambassador. \( *e_1 > e_2 \)

Since at least Partee (1984), the source of such temporal inferences has loomed large in the literature. Earlier reference time theories focused principally on cases of narrative progression,
building elaborate semantic models of how the reference time of a sentence is anaphoric to preceding discourse (Partee 1984; Hinrichs 1986; Dowty 1986; Webber 1988; Kamp and Reyle 1993, a.o.). For most of these approaches, though not Webber’s, reference times could never resolve to a time prior to the most recent event, and so the existence of backshifting in the interpretation of past tense discourses was a stubborn inconvenience.

More pragmatic discourse coherence theories arose in response, which posit that speakers infer coherence (or rhetorical) relations between sentences, drawing on a small inventory of such relations each with specific spatio-temporal consequences (Kehler 2002; Lascarides and Asher 1993; Asher and Lascarides 2003, a.o.). For instance, when a Narration relation is inferred between two sentences, to use Asher and Lascarides’s terminology, they have a forward moving temporal interpretation; but when an Explanation (i.e., causation) relation is inferred, they instead have a backshifted interpretation.

Both these approaches assume that narrative progression and backshifting arise from the same source. Based on the contrast in (2a–b), however, we argue that they are not a package deal. There is a distinct mechanism for backshifting that the HP explicitly interferes with. Palmer’s quote above furnishes an intuitive characterization of where things go awry: the HP is a form of ersatz real-time description — backshifting is prohibited because the simulated “now” is ever moving forward. This paper advances a formal framework that makes good on this intuition.

This theory involves two independent pieces. The first is a general theory of temporal sequencing that allows narrative progression “for free,” while backshifting is explicitly anaphoric (cf. Webber 1988). The second is a bicontextual semantics for present tense that unifies the canonical use of the simple present in English and the HP (Anand and Toosarvandani, to appear). As we hope to show, once the temporal sequencing system is precisely delineated, the semantics of the present tense will conspire to eliminate the possibility of backtracking.

1. No going back!

For discourse coherence theories, temporal sequencing arises from larger coherence effects. The contrast in (3a–b) might, under such a view, be the manifestation of more general restrictions on intersentential discourse relations. Asher and Lascarides (2003: 471) propose something along these lines to account for the obligatory backshifting exhibited by the past perfect.

\[ \Box((\tau, \alpha, \beta) \land sp(\alpha) \land pp(\beta) \rightarrow C_{pp}(\alpha, \beta)) \]

Their constraint essentially eliminates all but Explanation and Elaboration discourse relations with the past perfect. In particular, it preempts Narration, which produces narrative progression.
Extending this idea to the contrast in (3a–b), the HP would be prohibited from entering into an Explanation relation, which is compatible with backshifting; it would thus only occur with forward-moving relations, such as Narration. This does not stand up to closer scrutiny, however. First, an HP sentence can be coherently followed by a sentence in a range of tenses — simple past, present perfect, past perfect — that do allow backshifting interpretations. These would presumably be linked by an Explanation relation.

(6) The administration fires\(e_1\) Mike. He \{met, has met, had met\}\(e_2\) with the ambassador. \(e_1 > e_2\)

Moreover, a sentence in the HP can be connected by the full range of discourse relations to a preceding sentence, including Explanation, just as long as there is no backshifting. In other words, two HP sentences can stand in an Explanation relation (7a), as well as an Elaboration (7b), Background (7c), or Violated Expectation (7c) relation, with the eventualities they describe simply overlapping.

(7)  
a. **Explanation**  
Liz collapses\(e_1\) onto the couch. She is exhausted\(e_2\) from practice. \(e_1 \circ s_2\)

b. **Elaboration**  
Donald has\(e_1\) a lovely meal that night. He eats\(e_2\) lots of well-done steak. \(e_1 \supset e_2\)

c. **Background**  
Senecal opens\(e_1\) the door. The room is\(e_2\) pitch black. The fan is running\(e_3\). \(e_1 \circ s_2 \circ s_3\)

d. **Violated Expectation**  
I offer\(e_1\) him a drink with dinner, but \{he refuses\(e_2\) \#he drinks\(e_2\) one earlier\}. \(e_1 < e_2\) \(e_1 > e_2\)

In short, the restriction on intersentential discourses in the HP is a purely temporal one, not one that can be stated in terms of coherence relations.

(8) **Constraint on Intersentential Historical Present (CHP)**  
An eventuality can temporally follow or overlap the eventuality just described, but cannot temporally precede it.\(^1\)

To ensure the ecological validity of the CHP, we examined N. K. Jemisin’s *Obelisk Gate*, a recent 450 page novel written in the HP that is notable for complex temporal shifts throughout

\(^1\)As we discuss in Section 5, intra-sentential relations are more liberal. Backshifting possible in the HP with overt connective (e.g., after, because, even though).

(1)  
a. He returns\(e_1\) to the gym after he breaks\(e_2\) his leg. \(e_1 > e_2\)

b. He cancels\(e_1\) his gym membership because he breaks\(e_2\) his leg. \(e_1 > e_2\)

c. Donald is forgiven\(e_1\) even though he breaks\(e_2\) the law. \(e_1 > e_2\)
the text, often within a single chapter. The book contains many instances involving backshifting, all involving either the simple past or present perfect. A selection of cases where substituting in the simple present (for the bolded verb) yields sharp ungrammaticality follows.

(9)  
a. Nassun doesn’t have any money beyond her allowance you see and she’d already spent that on books and sweets when word came that a lorist was in town.  
   (p. 5)  
b. He murmurs to her, “get your things…” Jija’s mother married again a few years back and now she lives in Sume, the town in the next valley over, which will soon be destroyed utterly.  
   (p. 10)  
c. He’s completely the same, aside from being partially turned to stone, as the days when you and he were less than lovers and more than friends. Ten years and another self ago.  
   (p. 12)  
d. Her teeth have been filed to points, even though sanzeds supposedly stopped doing that centuries ago.  
   (p. 17)  
e. There are no travelers on the road though you can tell that the ash is thinner there. People have been by recently.  
   (p. 30)  
f. But she tries, because once upon a time, this man was her world.  
   (p. 312)

There is exactly one clear counterexample to our generalization, and it comes in a chapter that quickly sketches several crisscrossing plot threads — one at a time — across six months time. The basic skeleton of this section is delineated below.

(10) Six months pass…  
    Tonkee’s arm survives the reattachment…She lives\textsuperscript{e1}…  
    (p. 235)  
    Hjarka starts courting\textsuperscript{e2} Tonkee…She’s mostly just confused…  
    (p. 236)  
    Tonkee brings\textsuperscript{e3} the council a new predictive model…some comm members will start showing deprivation symptoms within a year…  
    (p. 237)  
    Ykka doesn’t want to tell anyone…You and the other council members agree\textsuperscript{e4} reluctantly…  
    (p. 239)  
    But because of Ykka’s silence, a Breeder visits\textsuperscript{e5} you a few days after you bring\textsuperscript{e6} Tonkee home to finish recuperating.  
    (p. 239)  
    Alabaster suffers\textsuperscript{e6} another bad infection during these six months. He survives\textsuperscript{e7} it only by…  
    (p. 240)  

\[ e_1 < e_1' < e_5 < e_2 < e_3 < e_6 < e_7 < e_4 \]

The offending sentence describes a visit (e\textsubscript{5}) to the addressee (Essun) that happens very soon after events pick up in the chapter, but that is presented linearly rather far after the culmination of the first main thread (the prediction of a food shortage by a recently healed scientist, Tonkee).

However, this sentence itself starts another thread (about Essun’s romantic entanglements), and it comes with a paragraph break that indicates the start of a new topic. Hence, it may signal a break in overall discourse coherence. Regardless of the ultimate explanation for this pattern, the
fact that it is the only exception to our generalization in the entire novel (despite considerable temporal shifts) is a testament to its essential correctness.

2. Problems for reference time theories

The CHP presents significant problems for a discourse coherence theory. For reference time theories, on the other hand, it is not this generalization that is problematic, but the possibility of temporal backshifting with the simple past. The Temporal Discourse Interpretation Principle in Dowty (1986), for instance, simply prohibits it. A notable counterexample is Webber’s (1988) theory, in which reference times can be anaphoric to subparts of events: anaphora to a consequent state yields narrative progression (11a), while anaphora to a prestate (preparatory phase) yields backshifting (11b).

(11) a. \[ E_b \rightarrow \text{conseq}(E_b) \rightarrow \text{Now} \]
    b. \[ E_b \rightarrow \text{prep}(E_a) \rightarrow \text{Now} \]

While Webber does not link these anaphoric processes to morphosyntactic categories, the CHP might be seen as evidence that they should be. The only workable move would be to stipulate that the simple present cannot be anaphoric to prestates. This derives the CHP, but it is not clear why it should be. (Note that stipulating the inverse — that HP sentences do not make their prestates available for anaphora — would not allow backshifting with the simple past, as in (6).)

There have been attempts to relate backtracking to particular aspectual combinations. For instance, Bittner (2008) argues that backshifting results from English being aspectually underspecified (unlike, say, Kallalisut). An eraswhile instantaneous event can be construed as a process, such that the event described by a subsequent sentence can be located inside the consequent state of one of its subparts. Thus, the second sentence in (2b) is backshifted when the firing event is seen as an extended process beginning at least as far back as the meeting with the ambassador. An argument for this underspecification come from what appears to be reference to an achievement as either an instantaneous event or a process.²

(12) I came to the conference. \{ At that instant, I knew I made a mistake. The process was exhausting. \}

²We think there is some reason to doubt this argument. If aspectual underspecification is responsible would not easily explain why, in (2b), the two sentences can be restricted by non-overlapping temporal frame adverbials: e.g., Today, the administration fired Mike. Six months ago, he met with the ambassador. Nor for why a durative temporal adverbial, such as for the past six months, is illicit with the first sentence.
However, to the extent that (12) allows both references, so does the corresponding HP version.

(13) I come to the conference. \{ At that instant, I know I made a mistake. \}
\{ The process is exhausting. \}

Thus, if aspectual underspecification is responsible for backshifting, it should be allowed with the HP, contrary to fact.

Rather than the first sentence, it might be the backshifted sentence itself that is ambiguous. Building on Kratzer (1998), Dickey (2001) claims that the simple past in English is ambiguous between a “true” past (reference time precedes the utterance time), which leads to narrative progression, and a past perfect, which leads to backshifting. By contrast, in Dutch, Dickey argues that the simple past always yields narrative progression, citing similar facts in German. From this perspective, the CHP might arise simply because the simple present lacks this kind of morphological syncretism.

But if simple past morphology in English disguises structural past perfect, it should be possible to replicate ambiguities associated with perfects. In one such ambiguity, sentence-final temporal adverbials can constrain either the event time or the reference time; in contrast, sentence-initial adverbials only constrain the reference time (Hornstein, 1990: 24–25).

(14) ‘His leaving was at noon.’ ‘By noon, he had already left.’
  a. He had left at noon. ✓ ✓
  b. At noon, he had left. # ✓

(15) ‘His leaving was at noon.’ ‘By noon, he had already left.’
  a. He left at noon. ✓ #
  b. At noon, he left. ✓ #

If the simple past permitted a past perfect structure, it should have a reference-time constraining interpretation. But this is not the case, for either a sentence-final (15a) or sentence-initial (15b) adverbial. Thus, backshifting is unlikely to derive from an ambiguity in the simple past.

3. A bicontextual semantics for the present

We will present a theory of temporal sequencing that treats backshifting as anaphora to the preceding discourse. This builds on a bicontextual semantics for the present tense that we have argued for elsewhere (Anand and Toosarvandani, to appear). It assumes that natural language expressions are interpreted relative to two contexts: a context of utterance \( \langle u \rangle \) and a context of assessment \( \langle a \rangle \). Such bicontextualism has been deployed in several empirical domains, including for free indirect discourse (Doron, 1991; Schlenker, 2004; Sharvit, 2004, 2008; Eckardt, 2015) and future tense (MacFarlane, 2003), as well as predicates of personal taste and epistemic modals (MacFarlane, 2014).
3.1. The semantics of tense

Individual expression can be sensitive to one, the other, or both of these contexts. Adopting the division that Sharvit (2004, 2008) proposes, local pronouns are sensitive to the utterance context, while tense is sensitive to the assessment context.

(16) a. \([I]^{u,a,g} = \text{SPEAKER}(u)\)
    b. \([\text{you}]^{u,a,g} = \text{ADDRESSEE}(u)\)

(17) a. \([\text{PRES}_i]^{u,a,g}\) is defined iff \(g(i) \subseteq \text{TIME}(a)\). When defined, \([\text{PRES}_i]^{u,a,g} = g(i)\)
    b. \([\text{PAST}_i]^{u,a,g}\) is defined iff \(g(i) < \text{TIME}(a)\). When defined, \([\text{PAST}_i]^{u,a,g} = g(i)\)

Sharvit takes temporal and locatival adverbials, such as *tonight* (18a) and *here* (18b), to be sensitive to the assessment context.

(18) a. \([\text{tonight}]^{u,a,g} = \text{the night of the day surrounding } \text{TIME}(a)\)
    b. \([\text{here}]^{u,a,g} = \text{LOCATION}(a)\)

While Sharvit assumes that the two contexts are always identical in root contexts, Anand and Toosarvandani (to appear) propose that the assessment context can be freely chosen at the root level, subject to pragmatic considerations, cf. Schlenker (2004)

(19) **Canonical Present**
    \(\text{TIME}(a) = \text{TIME}(u)\)

(20) **Historical Present**
    \(\text{TIME}(a) < \text{TIME}(u)\)

Overlap between the assessment time and the events being described corresponds to the felt vividness of the HP, i.e., the sense of narrating something unfolding before one’s eyes (Palmer 1965: 39, Leech 1971: 6–7, Close 1981: 106).

In addition, assuming that the simple present is always perfective aspect — the run time of the eventuality is contained in the reference time — only stative predicates will be compatible with the canonical present, as only they describe an eventuality small enough to fit within the assessment time, which is just as narrow as the utterance time (Cowper, 1998; Wurmbrand, 2014; Todorović, 2015). In the HP, however, the assessment time is unmoored from the utterance context, and hence it can be wide enough to contain a non-stative eventuality.

3.2. Updating the assessment time

The time of the assessment context can, in principle, change across sentences. After the initial segment of a discourse, we propose that is freely updated, subject only to the **Constraint on Assessment Time Update (CATU)**.
(21) Constraints on Assessment Time Update (CATU)
For a sentence $S$ and an eventualities stack $E$, $S$ can be evaluated with respect to contexts $u$ and $a$ such that:

a. $\text{TIME}(a) := \text{TIME}(u)$, or
b. $\text{TIME}(a) := t$ such that $\forall t'(t' < t \rightarrow t' < \tau(e_0)) \land \forall t'(t' < \tau(e_0) \rightarrow t' < t)$

The first condition is natural: the utterance context is always a possible anchor for assessment time. The second condition invokes a stack of eventualities to which states or events are added (cf. Grosz and Sidner 1986; Webber 1988; Bittner 2003, 2005, 2008). As each sentence is interpreted, the eventuality it describes is pushed onto the stack. The top ($e_0$) represents the most recent and most salient eventuality in the discourse.

(22) Eventualities stack
$E = \langle e_0, \ldots, e_n \rangle$

According to its second condition, CATU allows for the left boundary of $\text{TIME}(a)$ and $\tau(e_0)$ to coincide, though there is no limit on the length of $\text{TIME}(a)$. Both (23a) and (23b) are, in principle, possible updates of the assessment time. In practice, the width of the assessment time will be constrained pragmatically. The Maxim of Quantity will impose a narrower time interval, corresponding to a more informative utterance.

(23)

Before showing how this derives the (im)possibility of backshifting, something must be added for initial segments. At the beginning of a discourse, the assessment context can be anchored to the utterance context, but it need not be: a sentence in the HP can start off a discourse. In this case, no salient event has been introduced yet for $\text{TIME}(a)$ to be updated to. So, for initial discourse segments, we propose that the assessment time can be self-anchored, so that it shares the left boundary of the the event the sentence itself describes.

(24) Constraints on Initial Assessment Times (CIAT)
For a sentence $S$ describing an eventuality $e$ and an eventualities stack $E = \langle \rangle$, $S$ is evaluated with respect to contexts $u$ and $a$ such that:

a. $\text{TIME}(a) := u$, or
b. $\text{TIME}(a) := t$ such that $\forall t'(t' < t \rightarrow t' < \tau(e)) \land \forall t'(t' < \tau(e) \rightarrow t' < t)$.
While CIAT determines the startup update, subsequent updates are constrained entirely by CATU. This derives the availability of backshifting with the simple past, as well as its unavailability with the HP.

3.3. Backshifting as anaphora

We take backshifting to arise anaphorically when \( \text{TIME}(a) \) is updated to left-align with the most salient event in preceding discourse — that is, the top of the event stack. For a sentence in the simple past, backshifting is thus a possibility when it follows another sentence in the simple past.

\[(25)\]

a. The administration fired\( e_1 \) Mike. He met\( e_2 \) with the ambassador. \( e_1 > e_2 \)

b. \[ \begin{array}{c}
S_1: \ \\
\hline
\begin{array}{c}
\bullet \\
\circ \\
e_1 \\
\end{array}
\end{array} \]

\[ e_1 < a = u \]

\[ \begin{array}{c}
S_2: \\
\hline
\begin{array}{c}
\bullet \\
\circ \\
e_2 \\
\end{array}
\end{array} \]

\[ e_2 < a \neq e_1 \]

But for a sentence in the HP, backshifting is ruled out entirely. Let us start with an HP sentence following one in the simple past. Then the assessment time can be updated to left-align with the most salient preceding event, but the semantics of present tense (coupled with perfective aspect) will locate the event described inside the assessment time, rather than anterior to it.

\[(26)\]

a. The administration fired\( e_1 \) Mike. He meets\( e_2 \) with the ambassador. \( *e_1 > e_2 \)

b. \[ \begin{array}{c}
S_1: \ \\
\hline
\begin{array}{c}
\bullet \\
\circ \\
e_1 \\
\end{array}
\end{array} \]

\[ e_1 < a = u \]

\[ \begin{array}{c}
S_2: \\
\hline
\begin{array}{c}
\bullet \\
\circ \\
e_1 \ e_2 \\
\end{array}
\end{array} \]

While the only interpretation the discourse in (26b) can have is a forward moving one, the earliest a sentence in the HP might be interpreted is as overlapping with the preceding sentence.

\[(27)\]

The administration fired\( e_1 \) Mike. Trump fires\( e_2 \) Sean at the same time. It’s\( s_3 \) a real bloodbath. Kellyanne is\( s_4 \) on TV nonstop.

\[ e_1 \circ e_2 \circ s_3 \circ s_4 \]
The same logic applies to a sequence of sentences entirely in the HP. The assessment time already precedes the utterance time for the first sentence. But with just the event it describes available as the top of the eventualities stack, there is no way of updating the assessment time so that the second sentence is temporally anterior, given the semantics of the present tense.

\[(28)\]

\(a.\) The administration fires\(e^1\) Mike. He meets\(e^2\) with the ambassador. \(e^1 > e^2\)

\(b.\) \(S_1:\)

\(S_2:\)

In sum, then, backshifting arises through anaphora to a salient event in the discourse. It is, as a consequence, impossible in the HP, which can only locate an event inside the assessment time.

3.4. Backshifting with the perfect

Just like the simple past, a sentence in the HP is able to “anchor” backshifting with a sentence in the simple past. This is also possible with the past perfect.

\[(29)\]

\(a.\) The administration fires\(e^1\) Mike. \(\{\) He met\(e^2\) with the ambassador. \(\}

\(b.\) \(S_1:\)

\(S_2:\)

The simple past can have a backshifted interpretation here for the same reason it can in (25), except that no update of the assessment time is necessary. It is self-anchored prior to the utterance time by the first sentence, which the second sentence is then located temporally anterior to.

The equivalence of the past perfect in this discourse follows from its semantics. Building on Kamp and Reyle (1993), Anand and Toosarvandani (to appear) take it invoke a perspective
point, which they identify with the assessment time. The past perfect would thus locate the reference time of a sentence prior to the assessment time (30b), which itself must precede the utterance (30a).

(30)  

A bicontextual semantics for the past perfect

a. \( \text{TIME}(a) < \text{TIME}(u) \)

b. \( g(i) < \text{TIME}(a) \)

c. \( \exists e (P(e) \land \tau(e) \subseteq g(i)) \)

These conditions are automatically satisfied in the discourse depicted in (29b), as the HP requires the assessment time to precede the utterance time.

Even if the first sentence is in the simple past, the past perfect will necessarily involve backshifting. To satisfy the first condition in (30), the assessment time must be updated to left-align the most salient preceding event.

(31)  

a. The administration fired\(^{e1}\) Mike. He had met\(^{e2}\) with the ambassador.

b. \( S_1: \)

\[ e_1 < a = u \]

\( S_2: \)

\[ e_2 < a \parallel e_1 \]

For the past perfect, then, backshifting arises as a necessary consequence of its semantics, regardless of what comes before it in the discourse.

3.5. The present perfect

After the HP, the present perfect, too, admits a backshifted interpretation. This is roughly equivalent to backshifting with the simple past or past perfect in (29a) above.

(32)  

The administration fires\(^{e1}\) Mike. He has met\(^{e2}\) with the ambassador.  

\[ e_1 > e_2 \]

A straightforward semantics for the present perfect yields the correct result. The perfect can locate the reference time in the result state of an event, which the present tense then presupposes is included in the assessment time.

(33)  

Present perfect in a bicontextual framework
Then, just as depicted in (29b), the event described by the present perfect sentence will be anterior to the event of the first sentence.

An interesting effect arises when the antecedent sentence is in the simple past. While the present perfect is licensed with a backshifted interpretation, as in (34a), there is a felt difference to the parallel discourse with the past perfect in (31).

(34)  

a. The administration fired\textsuperscript{a1} Mike. He has met\textsuperscript{a2} with the ambassador.

b. Our account permits such discourses, as the assessment time can be updated to left-align with the top of the eventuality stack for the second sentence. But it does not account for the particular effect of using the present perfect here, as opposed to the past perfect. We suspect that it may arise from other well-attested differences between the present and past perfect, including lifetime effects, current relevance, and incompatibility with temporal adverbials (see, e.g., Portner 2003).

4. Narrative progression

If backshifting arises through anaphora to the preceding discourse, narrative progression must derive from another mechanism that is constant across differences in tense. We will not attempt here to state directly what this mechanism is. Rather, our approach will be simply to make space for it, given our semantics for tense and the conditions on updating the assessment context.

In reference time theories, narrative progression is a direct result of temporal anaphora, as constrained by grammatical aspect (Hinrichs, 1986; Partee, 1984; Dowty, 1986; Webber, 1988). In one version of such a theory, sentences in the perfective aspect introduce a novel time interval “immediately after” the event they describe, which can serve as the antecedent for the reference time of a subsequent sentence. A sequence of simple past sentences, then, can only be interpreted as forward moving.

In discourse coherence theories, narrative progression arises from the spatio-temporal constraints associated with a specific discourse relation, such as Asher and Lascarides’s (2003) Narration (see also Lascarides and Asher 1993 Altshuler 2016: 67–70), that is assumed as a de-
fault. That is, in the absence of contradictory grammatical or other information, speakers infer that events occur in a sequence and are tightly contiguous, both temporally and spatially.

These approaches share some common intuitions. To start, they agree that narrative progression is the default, arising in the absence of information to the contrary. This is tied, in some sense, to the Maxims of Manner and Relevance, which together mandate a forward moving interpretation. And, an important constraint under both approaches is that no significant event intervene between the events in a narrative. Either one must occur “just after” another (Partee, 1984: 254) or “where things are at the end of [the first event] is where they are at the beginning of [the second event]” (Asher and Lascarides, 2003: 162). This involves considerations of Relevance.

Given these considerations, narrative progression should arise whenever it is not blocked by conflicting information — by, for instance, backshifting through anaphora to a salient event. This happens in at least two contexts. For a series of sentences entirely in the simple past, when the assessment time is not updated, nothing prevents their forward sequencing.

\[(35)\]

\begin{align*}
\text{a.} & \quad \text{The administration fired}^{e_1} \text{ Mike. He lost}^{e_2} \text{ his house.} & e_1 < e_2 \\
\text{b.} & \quad S_1: & e_1 < a = u \\
& \quad S_2: & e_2 < a
\end{align*}

Similarly, for a sequence entirely in the HP, each new event will be located within the same assessment time interval, which is not updated, in close temporal succession.

\[(36)\]

\begin{align*}
\text{a.} & \quad \text{The administration fires}^{e_1} \text{ Mike. He loses}^{e_2} \text{ his house.} & e_1 < e_2 \\
\text{b.} & \quad S_1: & e_1 \geq a < u \\
& \quad S_2: & e_2 \subseteq a
\end{align*}

If the discourse in (36a) were extended with an additional sentence, this would necessarily describe an event located “just after” the last one, since there can be no significant events that intervene between the events already described (37a). This inference does seem like it can be
cancelled (37b), which is compatible with it being an implicature arising from Manner and Relevance.

(37)  

a. The administration fires\(^{e_1}\) Mike. He loses\(^{e_2}\) his house. \(\#He \ \text{misses}^{e_3}\) a house payment.

b. The administration fires\(^{e_1}\) Mike. He loses\(^{e_2}\) his house. Actually, he first misses a house payment, and then he loses his house.

In fact, events are forward sequenced regardless of the location of the assessment time and whether it has been updated, as long as narrative progression is not prohibited. As Schiffrin (1981: 46) shows, the HP can alternate freely with the simple past without there necessarily being any backshifting.

(38)  

a. Then all of a sudden everybody \textit{gets}^{e_1}\) involved and they \textit{made}^{e_2}\) a mess. So uh...this lady \textit{says}^{e_3}\) uh this uh Bert, “Oh, my son’ll make them. He’s an electrician.” So he \textit{makes}^{e_4}\) them, and he \textit{charges}^{e_5}\) all the neighbors twenty dollars a set, and there I \textit{paid}^{e_6}\) three dollars. So I \textit{called}^{e_7}\) her a crook. And I \textit{called}^{e_8}\) her son a crook. So, they \textit{were}^{e_9}\) really mad at me.

\[
\begin{align*}
e_1 &< e_2 < e_3 < e_4 < e_5 < e_6 < e_7 < e_8 \circ e_9 \\
\text{(Schiffrin, 1981: 46)}
\end{align*}
\]

b. 

\[\text{Though the assessment time is variously updated to the utterance time or the top of the event...}\]
stack, the principles behind narrative maintain a forward moving interpretation across the events described.

5. Conclusion and future prospects

Starting from the observation that backshifting is forbidden with sentences in the HP, we have motivated a more complex description of the pragmatics of temporal sequencing. At the same time, we have furnished an argument that temporal morpho-semantics can constrain discourse relations, a point that has gone unremarked given the literature’s focus on past-past sequences. As Table 1 shows, our account correctly predicts interpretive possibilities for all possible continuations of simple past and HP sentences. Moving forward, we hope to tackle three additional, more complex discourses than considered here.

The first are intra-sentential temporal adjunct clauses, which can yield apparent backshifting in the HP.

(39)  
\begin{align*}
a. & \text{He returns}^{e_1} \text{ to the gym after he breaks}^{e_2} \text{ his leg.} & e_1 > e_2 \\
b. & \text{He cancels}^{e_1} \text{ his gym membership because he breaks}^{e_2} \text{ his leg.} & e_1 > e_2 \\
c. & \text{Donald is forgiven}^{e_1} \text{ even though he breaks}^{e_2} \text{ the law.} & e_1 > e_2
\end{align*}

Here, we suggest that, internal to a sentence, TIME(a) can be set wide enough to contain both events, whose order is determined entirely by the temporal connective.

\begin{figure}
\centering
\includegraphics[width=0.5\textwidth]{figure40}
\caption{Diagram showing intra-sentential backshifting.}
\end{figure}

Though these adjunct clauses permit intra-sentential backshifting, they shift prior to events introduced in previous sentences. For example, (41) presents five events, with the first four

\begin{enumerate}
\item Liz has entered the room. She has taken off her shoes. She has dropped her bag on a chair.
\end{enumerate}

\begin{table}[h]
\centering
\begin{tabular}{|c|c|c|c|c|}
\hline
          & FWD   & BACK &          & FWD   & BACK \\
\hline
PRES – PRES & ✓ (36) & * (28) & PAST – PRES & ✓ (38) & * (26) \\
PRES – PAST & ✓ (38) & ✓ (29) & PAST – PAST & ✓ (35) & ✓ (25) \\
PRES – PRES PERF & * (32) & ✓ (32) & PAST – PRES PERF & * & ✓ (34) \\
PRES – PAST PERF & * (29) & ✓ (29) & PAST – PAST PERF & * (31) & ✓ (31) \\
\hline
\end{tabular}
\caption{Summary of discourse types accounted for}
\end{table}
intuitively following each other in succession. While $e_5$ can be understood to squeeze between $e_3$ and $e_4$, continuations which locate it before $e_1$ to $e_3$ are significantly degraded.

(41) Mike is nominated$^{e_1}$ and confirmed$^{e_2}$. Controversy swirls$^{e_3}$. Then, the administration fires$^{e_4}$ him because he meets$^{e_5}$ with the ambassador {"?before his nomination, "?before his confirmation, "?before the controversy’s explosion}).

In our current theory, two distinct principles are at play. While discourse-initially, TIME($a$) could be constructed to contain both $e_4$ and $e_5$ in the distant past, in (41), CATU will prevent the left boundary of TIME($a$) from retreating before $\tau(e_1)$ (the initial left boundary imposed by CIAT). This will then forestall $e_5$ from being located before $e_1$. For $e_2$ and $e_3$, this reasoning isn’t enough, since any $e_5$ in between those and $e_4$ could still fall within the existing TIME($a$). Can we simply insert an event between two events linked by narrative progression? What we suggested in Section 4 is that since narrative progression comes with the inference that no noteworthy or relevant event intervenes between two narratively sequenced events, the only way to do this would be to shift TIME($a$) anaphorically to coincide with $e_3$. And given the semantics for the present tense, this would mean neither $e_4$ nor $e_5$ could precede $e_3$.

Beyond this issue, our theory of backshifting is currently framed in terms of a salient event, which would mean that temporal frame adverbials should not facilitate backtracking in the HP. Preliminarily, this prediction seems to hold for indexical adverbs like on Tuesday, but dependent temporal adverbials, in Hinrichs’s (1986) terms, like two days earlier do seem to facilitate something akin to backshifting. We need to conduct further research into this.$^4$

(42) Carol is a well-liked and well-evaluated middle manager at Wells Fargo. But everything fell apart for her in the first week of January 2017.

   a. On Friday, Wells Fargo fired$^{e_1}$ her summarily. {On Tuesday, Two days earlier}, she brought$^{e_2}$ potential cases of fraud to her managers. $e_1 > e_2$

   b. On Friday, Wells Fargo fires$^{e_1}$ her summarily. {*On Tuesday, ?Two days earlier}, she brings$^{e_2}$ potential cases of fraud to her managers. $e_1 > e_2$

Finally, though we have considered only two sentence discourses, it is important to consider longer and more structured discourses. It is typically understood that discourse is organized hierarchically, with backward sequencing signalling an embedded discourse segment (Grosz and Sidner 1986; Mann and Thompson 1988; Asher and Lascarides 2003, a.o.), such as the move back in (43) to a cluster of events about Fred’s morning regimen.

(43) Fred arrived$^{e_1}$ at 10. He had got up$^{e_2}$ at 5; he had taken$^{e_3}$ a long shower. He had got$^{e_4}$ dressed and eaten$^{e_5}$ a leisurely breakfast. He had left$^{e_6}$ the house at 6:30.

$^4$One reason we are cautious about claiming that this is backshifting is a feeling that the two sentences are less connected; it does not feel like second sentence furnishes an explanation for the first. This is reminiscent of the feelings Dickey (2001) reports for attempted backshifting in the Dutch simple past with initial temporal adverbial topics.
This hierarchical organization broadens the set of possible antecedents for anaphora. While we restricted anaphoric anchors to only the eventuality described by the most recent sentence, when a discourse segment is embedded, the sentence dominating this segment also remains accessible as a possible antecedent (cf. Right Frontier Constraint; Polanyi 1988).

(44) Fred arrived\textsuperscript{e1} at 10. He had got up\textsuperscript{e2} at 5. The night before, he had ironed\textsuperscript{e3} his suit and had packed\textsuperscript{e4} his suitcase, so he could get on the road quickly. \textsuperscript{e5} < \textsuperscript{e4} < \textsuperscript{e3} < \textsuperscript{e2} < \textsuperscript{e1}

a. He had left\textsuperscript{e5} the house by 5:30 and gone directly to his destination. \textsuperscript{e2} < \textsuperscript{e5}

b. He greeted Mary as soon as he got there. \textsuperscript{e1} > \textsuperscript{e5}

Thus, our system needs to grow to enable coherent returns to a higher discourse segment. A straightforward implementation of this would be to create stacks for each embedded discourse segment introduced. Then CATU would be understood as licensing anaphora only to those eventualities that introduce an embedded discourse segment, as only these are the top of an eventualities stack. We suspect that such an approach can handle the complex case in (10), but much further investigation is needed.

References


Roles and the compositional semantics of role-denoting relational adjectives
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Abstract. The semantics of adjectives related to nominals denoting societal roles, such as presidential (from president), have remained understudied. We examine the semantics of what we call role-denoting relational adjectives, providing a formal analysis using the notion of a frame, a unified representation for lexical knowledge, world knowledge, and context. The frames we propose are based on a constructivist philosophical understanding of social roles, leading us to posit a multi-tiered ontology of events and individuals. Using frames and our ontology, we provide a general semantics for role-denoting relational adjectives and roles.

Keywords: modification, adjectives, relational adjectives, events, non-intersective adjectives, roles, natural language metaphysics, frame semantics.

1. Introduction

1.1. Presidential affairs

Some role nominals such as president show an ambiguity between readings related to an official role and to readings related to the person inhabiting the role. In (1), the natural interpretation for the sentence is that the president as a private person visited his mother; no inference arises that this was part of the official duties of being president. However, in (2), that inference is possible. The natural interpretation is that this was an official visit as part of the duties of the office. Correspondingly, president in (1) refers to simply the person inhabiting the office, while in (2) the same nominal has a preference to refer to the person qua officeholder, the person inhabiting the role.

That these predications involve meanings of a particular sort (e.g., inferences regarding whether events are related to particular official responsibilities or not) can be demonstrated with certain modifiers such as private (for personal acts) and as head of state (for official acts), which serve to single out certain interpretations of these sentences.

(1) The president visited his mother. (personal visit preferred)
(2) The president visited the Canadian prime minister. (official visit preferred)

The different readings of these sentences are driven in large part by our understanding of social roles in the world. Heads of state (like Canadian prime minister Justin Trudeau) are visited in the course of carrying out the official duties and responsibilities of an office. On the other hand, one’s family are (typically) not in a social role that would make them eligible for being visited

1 We thank Henk Zeevat, Willi Geuder, Wiebke Petersen, Gottfried Vosgerau, Gerhard Schurz, Markus Schrenk, Katja Gabrovská, Ai Taniguchi, and audiences at Sinn und Bedeutung 22, TbiLLC 2017, Heinrich-Heine-Universität Düsseldorf, and Carleton University for their comments and discussion. This work was supported by DFG SFB 991 “The Structure of Representations in Language, Cognition, and Science,” project C10. All errors are our own.
in an official capacity. Thus, our understanding of the relationship between the responsibilities and duties of offices, of heads of state (and other state-level actors) and private persons bears directly on our conceptualization of the semantics of role terms.

English allows for ways of converting nouns to adjectives, such as with the -al suffix. When these role nominals arise as adjectives (i.e., president to presidential), however, a puzzle arises with attributions similar to the ones in (1) and (2). If we assume, as we will below, that the use of the adjective within an NP implicitly relates to a potential referent of the root noun, we observe that the adjective can relate (in this sense) only to the office, not to the incumbent, unlike the root noun itself. The pattern is demonstrated in (3), where the deverbal noun visit, when modified by presidential, allows only for a reading related to official action by a president; conversely, the sentence in (4) does not entail that the visit was an official visit.

(3) a presidential visit \{ to the president’s mother, to the Canadian prime minister \}

(4) The president visited his mother.
No entailment: There was a presidential visit to the president’s mother.

A distinction in the readings available manifests with adjectival modifiers versus Saxon genitives as well. Saxon genitives allow for a reading where the possessed object is interpreted as relating to the possessor as a person. However, the adjective only allows for an interpretation where the possessed object must relate to the possessor in the context of the role they inhabit. For instance, the presidential desk is the particular desk the president uses in their official duties, while the president’s desk could refer both to the presidential desk, but also to a desk they may happen to use as a private person (such as a personal desk used in a home study). Similarly, while the presidential advisor is the advisor to the president for matters relating to the office of president, the president’s advisor can also refer to an advisor who advises the president in a non-official way (such as a tax advisor).

(5) a. the president’s desk (personal reading possible)
   b. the presidential desk (role reading only)

(6) a. the president’s advisor (personal reading possible)
   b. the presidential advisor (role reading only)

Parallel observations apply to NN compounds: formations such as president advisor and president office, if acceptable, although unusual, would only have the office reading. There is a simple explanation for the parallel observations concerning the A+N construction and compounds: neither the adjective nor the modifier of the compound refers to what the adjective’s root noun and the first part of the NN compound would refer to when in referential use. In both cases, only the modified noun refers. In both constructions, the referent of the referring noun is

---

2 German would have compounds with the first noun Präsident instead of A+N constructions with the adjective derived from Präsident: Präsidentenberater (“presidential advisor”), Präsidentenekskorte (“presidential motorcade”), Präsidentenbesuch (“presidential visit”), Präsidentenamt (“presidential office”), and so on.
related to what would be the referent of the root or modifier noun. Being related to does not amount to reference, though. There can be a presidential desk without there being a president, or presidential advisors without a president to advise.

1.2. Co-nominal adjectives

In this paper, we focus on role-denoting relational adjectives. These form a subclass of adjectives that are in a morphological relationship to nouns and/or in a particular semantic relationship to them. In the prototypical cases, there is a noun and a morphologically derived adjective; sometimes, N and A are of the same form; sometimes the direction of derivation is from A to N; and sometimes there is no synchronic morphological relationship at all. We will refer to adjectives of this type as “co-nominal” and call the nouns they relate to their “co-nouns”; conversely, we refer to the adjectives related to the nouns as their “co-adjectives”. Table 1 illustrates A-N pairs of different morphological relation.

We propose to analyze co-adjectives as having essentially the same meaning as their co-nouns, except for two differences: (i) Co-adjectives do not refer, unlike their co-nouns; (ii) the components of the adjective meaning that correspond to the referential and possibly further arguments of the noun are not arguments. The first point accounts for the fact that adjectives and first compound components are not syntactically accessible to determination; for that reason they are also not eligible to direct anaphora. The second observation explains why these adjectives and compound components are not subject to syntactic binding. We will therefore assume the following relationship between, for example, the noun mother and its co-adjective maternal. The meaning of mother can be represented as in (7a), with the referential argument variable marked by underlining. The meaning of the co-adjective maternal would be the same, but with free variables instead of lambda-bound ones, and no variable with referential status (7b).

\[
\begin{align*}
N \rightarrow A & \quad \text{president – presidential} \\
& \quad \text{Canada – Canadian} \\
& \quad \text{parent – parental} \\
A \rightarrow N & \quad \text{electricity – electric} \\
& \quad \text{semantics – semantic} \\
& \quad \text{civilian – civil} \\
& \quad \text{municipality – municipal} \\
& \quad \text{electronics – electronic} \\
A = N & \quad \text{military – military} \\
& \quad \text{public – public} \\
& \quad \text{official – official} \\
A, N & \quad \text{pope – papal} \\
& \quad \text{mother – maternal} \\
& \quad \text{mind – mental} \\
& \quad \text{lungs – pulmonary} \\
& \quad \text{king/queen/prince/princess – royal} \\
& \quad \text{body – physical}
\end{align*}
\]

Table 1: Pairs of adjectives and co-nouns / nouns and co-adjectives

\[
\begin{align*}
\text{(7) a. } & \quad \text{mother} = \lambda x \lambda y. \text{mother}(x, y) \\
\text{b. } & \quad \text{maternal} = \text{mother}(x, y)
\end{align*}
\]
Thus, the semantic relationship between co-nominal adjectives and their co-nouns is essentially one of identity, while the difference in terms of arguments to be bound and treated as referential is due to the difference in grammatical category. Co-adjectives, one could say, are nouns in the guise of an adjective, or nouns functioning like an adjective.

While the notion of co-nominal A highlights its relation to a semantically closely related noun, we also want a new term for these adjectives when they combine with a noun. The term ‘relational’ adjectives has rightly been criticized as sub-felicitous (see Morzycki (2016: p.49)). It also is used in a way so as to cover adjectives of different semantic classes such as fake in fake gun, occasional in occasional smuggler, alleged in alleged thief, beautiful in beautiful dancer, and truly relational ones like municipal in municipal kindergarten, each plausibly requiring a different compositional analysis. We therefore introduce a new term for adjectives that are used to express a relation between two things: linking adjective (LA). This adjective class will include all co-nominal adjectives. What we called role-denoting relational adjectives above are a special case of co-nominal LAs with a role-denoting co-noun.

The paper is organized as follows: In section 2 we briefly discuss the kind-based analysis of relational nouns in McNally and Boleda (2004) and the later analysis in Arsenijevic, Boleda, Gehrke, and McNally (2014). We criticize these analyses for their use of kinds and for not capturing the wide range of possible relations involved with relational (i.e. linking adjectives). In section 3 we develop the ontological assumptions underlying our analysis, including a discussion of frame semantics, the representational framework we use, in section 3.4. Finally, sections 4 and 5 are devoted to our analysis of role-related adjectives.

2. Existing accounts of relational adjectives


McNally and Boleda (2004) argue that relational adjectives denote properties of kinds, in the sense of Carlson (1977), and not properties of ordinary individuals (as adjectives like happy or green are). McNally and Boleda (2004) build an account of RAs that takes inspiration from Larson’s 1998 analysis of non-intersective event-related modifiers like beautiful.

An observation with beautiful, going back at least to Siegel (1976), is that beautiful can have more than one pattern of modification: an intersective pattern where the adjective attributes a property to an individual, and a subsective pattern where the adjective attributes a property to an individual–event pair. Larson (1998) argues that adjectives like beautiful are always intersective, but can be predicates of different arguments when they are available. Abstracting away from the connective between the restriction of quantifier Q and its scope, in (8a), the modifier beautiful predicates of the individual who is a dancer (the individual olga), while in (8b), beautiful predicates of the event of dancing that the dancer participates in (event e).

(8)  a. \([\text{Olga is a beautiful dancer}] = Q_e[\text{dance}(e, \text{olga}) \ldots \text{beautiful}(\text{olga})]\)
    b. \([\text{Olga is a beautiful dancer}] = Q_e[\text{dance}(e, \text{olga}) \ldots \text{beautiful}(e)]\)
McNally and Boleda (2004) adopt this strategy of predicating non-intersective adjectives on other parameters. Following Carlson (1977), they assume that kinds are a basic sort, a basic sort of (abstract individuals), but unlike Carlson, they further assume that common nouns have a slot in their argument structure for a kind as well as a non-kind individual, making the denotations of common nouns relations between kinds and individuals.\footnote{Type $k$ for kinds, and type $o$ for individuals (objects).} The semantics for a common noun such as architect would thus look essentially like (9), where $R$ is a relation that holds between a kind and an individual just in case that individual is a member of that kind.

\begin{equation}
\langle \text{architect} \rangle = \lambda x_k \lambda y_o. R(x_k, y_o) \land \text{architect}(x)
\end{equation}

Having assumed kinds in their ontology, they proceed to suggest that certain adjectives denote properties of kinds rather than of individuals. The adjective technical (e.g., technical architect) is analyzed as denoting a property of kinds, as shown in (10).

\begin{equation}
\langle \text{technical} \rangle = \lambda x_k. \text{technical}(x_k)
\end{equation}

Lastly, they make the Larsonian move of saying that adjectives predicating of kinds can predicate of the kind argument of common nouns, just as adjectives predicating of events may predicate in certain circumstances of the event argument of some nouns.

\begin{equation}
\langle \text{technical architect} \rangle = \lambda y_o. \exists x_k. R(x_k, y_o) \land \text{architect}(x_k) \land \text{technical}(x_k)
\end{equation}

**Criticism** We object to the use of kinds in this way. Carlson introduces kinds as referents of generic indefinites or of species terms like dog. Ordinary common nouns in non-generic use, however, denote just a class, or type—of objects, not of kinds. It does not make much sense to assume that there are certain kinds that are architects, which is not the same as to assume that there are different kinds, i.e. subclasses, of architects. Even more questionable is the assumption that the adjective technical, along with a much more comprehensive crowd of other non-intersective adjectives, predicates about kinds. In our view, there is no property common to technical architects, technical problems, technical colleges, or technical instructions, except that they relate in some way or other to techniques. Not only do these things—be they kinds or just objects—have nothing in common if they are characterized as “technical” such things, they are even of ontological kinds so different that they can arguably be considered to not share any properties at all.\footnote{See Löbner (2017) on an ontology of objects in terms of possible attributes. The proposed formal approach to global frame-ontologies provides criteria for deciding if two individual objects can have properties in common.} Rather than assuming that LAs denote properties of kinds, we propose that these adjectives do not predicate at all. This accounts for the fact that they cannot be freely used predicatively.\footnote{On apparent counterexamples see the remarks in 2.2.} Analyzed like maternal in (7b), they do not have an argument to saturate.

We accept the attempt to “marry” A and N before they are applied to an object-type referent of the whole combination. For co-nominal As, this is essentially a marriage between two N concepts. There is no higher type involved than predication about objects, but the marriage is between concepts, not individuals (for example, a marriage of two type $\langle e, t \rangle$ concepts). In a conceptual approach to semantics, the concepts associated with nouns define a kind, or class, or...
type, of objects by describing a single case. The meaning of architect describes an object of
the type we call architects. The concept technical defines the abstract type of the adjective’s
co-noun technique(s). These two concepts are married so as to form one coherent concept that
includes both; let us notate this concept as technique $\leadsto$ architect. They must be linked in a
way that technique(s) figure in the architect concept as we understand the notion of technical
architect. N1 $\leadsto$ N2 is a cover notation that does not stand for any particular way of linking
two noun concepts. As we adopt frame format concept representations (or equivalently AVMs),
the connection between the two concepts/frames will be implemented by unification.

To summarize, we do not adopt a kind-based analysis. Rather, we propose to model the ‘marriage’
between a LA and an N as an operation which unifies the meanings of the two expressions.

2.2. Expansion of the kind-based approach to ethnic adjectives

Arsenijevic, Boleda, Gehrke, and McNally (2014) build on the analysis in McNally and Boleda
(2004) in analyzing ethnic adjectives (EAs), adjectives such as French and Canadian. They
argue that these adjectives always classify a nominal according to some physical location, such
as a nation. Some examples are given in (12), where in these cases the modified nominal is said
to have some relation to the nation the EA relates to.

(12) a. French wine
    b. French agreement (to participate in the negotiations)

The suggestion by Arsenijevic et al. is that the adjective encodes a thematic relation between a
kind and a country, what they call Origin. This relation holds of kinds and countries only if the
kind comes into existence within the spatial domain of the country:

(13) $\text{Origin}(x, y)$ iff $x$ comes into existence within the spatial domain of $y$

EAs, like RAs, target the kind argument of the common noun they modify, making them
intersective at the kind level. Crucially, the adjective, due to Origin, provides further constraints
on this intersection. This is illustrated in (14).

(14) $\llbracket \text{French wine} \rrbracket = \lambda y_0 \exists x_k \llbracket R(x_k, y_0) \land \text{wine}(x_k) \land \text{Origin}(x_k, \text{France}) \rrbracket$

Both of these analyses model the non-intersectivity of RAs and EAs by predicating the adjective
on a parameter other than the individual argument, with the analysis from Arsenijevic et al.
(2014) adding an layer of complexity by explicitly naming the relation that obtains between
a kind and the country named by the adjective. However, we think that this analysis is not
adequate for ethnic adjectives, and also cannot be transferred to role adjectives.

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6 Actually, this example is not easy to handle, as it is not quite clear what the co-noun of technical could be assumed
to be if it is to account for all the widely varying semantic contributions the A can effect.
7 See Löbner (2013: chapter 12) for the outlines of an account for analyzing N-N compounds along these lines.
Criticism  We share the idea that there is some relation that links the referent of the A’s co-noun to the noun the A combines with. However, it appears obvious to us that: (i) the linking relation, for LA’s whose co-noun denotes a country, is not always Origin; (ii) the linking relation is not unilaterally contributed by the LA; and (iii) the linking relation applies at the level of objects, for example, between the country and the objects the noun denotes.

As to the first objection, consider the following examples (from the BNC online corpus):


None of these can be paraphrased as ‘[N] with origin in the region of Canada.’ Rather, in each case, a different relation obtains between Canada and the referent of the noun. Obviously, the second noun itself participates in selecting the relation. Among the nouns in (15), government, prime minister, territory, citizenship, army, and policy are relational nouns and Canadian specifies their relational argument as Canada, the state. Similarly, geography and border are relational nouns with a region or country as an argument, here specified as Canada, the region (note that Canada, the state, is ontologically not the same as Canada, the region). In these cases, the relation is not contributed by the RA, and it is not Origin. Rather, the relation is defined in the lexical meaning of N, which specifies the relation between the referential argument and the relational argument. 8 This should not be taken to suggest that the linking relation is always contributed by the nominal concept; obviously, LAs combine with all types of nouns, including sortal nouns, which lack relational attributes. 9 Among the examples in (15), writer is a sortal noun. A Canadian writer may be a writer born in Canada, or a writer living in Canada, or a writer participating in the Canadian literary scene; in any event we may assume a bridging relation like ‘x was born in y,’ ‘x lives in y,’ or ‘x participates in the literary scene of y’ that takes Canada and the writer as the y and the x arguments, respectively. Thus the possible relations come from both the LA and the N, and how the different sorts of thing they denote can be connected.

Linking adjectives may have ‘sisters,’ adjectives of the same form that are lexicalized as ordinary intersective property adjectives (PAs). Canadian is certainly among them; there is a lexicalized sense variant that means basically ‘from Canada.’ The origin of this adjective can be considered to be due to a lexicalization of the LA with a particular linking to the country noun. Thus, there are two adjectives: the co-nominal LA Canadian and a property adjective Canadian 10 that implements a particular, frequent linkage of the LA; there is also the noun Canadian in the sense ‘native or inhabitant of Canada.’ There is nothing “inelegant” (Arsenijevic et al., 2014) in recognizing polysemy. In other cases of what appears to constitute predicative use of LAs, we assume that the LA is coerced into a PA by adding an argument and a relation to the co-noun content. For instance, there are predicative uses of the LA public like in (16):

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8 See Löbner (2013: p. 69) on the possessum-possessor relation inherent to the meanings of relational nouns.
9 See Löbner (2011) on types of nouns, including sortal and relational.
10 Morzycki (2016: p. 14ff), apparently relating to the PA variant, uses Canadian as a paradigm case of an intersective adjective.
The university is public, while nourished by the strong support of its alumni.\(^{11}\)

These uses seem to be acceptable only if there is support by using the LA frequently with a particular linkage supported by the argument noun of the predicative construction. The observation remains that this mechanism of coercion cannot be applied to the majority of LA-N combinations possible.\(^{12}\)

2.3. Applying the findings to *presidential*

The objections raised against the use of kinds in analyzing relational adjectives and assuming a particular relation encoded in the adjective carry over immediately to combinations of *presidential* with a noun. Here, too, we encounter a wealth of relations between the president and the noun referent, as shown in Table 2.

<table>
<thead>
<tr>
<th><em>presidential N</em></th>
<th>Relation</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>presidential election</em></td>
<td>election to determine the next president</td>
</tr>
<tr>
<td><em>presidential office</em></td>
<td>the office of president</td>
</tr>
<tr>
<td><em>presidential advisor</em></td>
<td>advisor to the president for official action</td>
</tr>
<tr>
<td><em>presidential visit</em></td>
<td>visit by the president as the president</td>
</tr>
<tr>
<td><em>presidential visit</em></td>
<td>visit to the president as the president</td>
</tr>
<tr>
<td><em>presidential motorcade</em></td>
<td>motorcade [for] escorting the president</td>
</tr>
</tbody>
</table>

Table 2: Relations encoded by *presidential N*

3. Ontological background

3.1. Social ontology

Our analysis will depend to a large degree on the ontology we assume in order to be able to talk about things like roles, offices, and official action. Following Searle (1995) we assume a layered ontology, with a higher-level social ontology carried by a lower-level physical ontology of “brute facts”. A human being is an entity in the lower ontology, while when considered a person they constitute a social being, a potential actor in society. The crucial relation that links the social world to the underlying physical world is the relation “\(X\) counts as \(Y\) in context \(C\)” Searle (1995: p. 28). Nodding one’s head is a physical action that may count as the social action of approval; a piece of metal or paper may count as money, a person may count as the president of a state—all under appropriate circumstances which are ruled, for example, by convention or law. We assume that the social ontology is in itself multi-layered; the count-as relation may hold between entities of different levels within the social ontology (for example, when the person Angela Merkel

\(^{11}\) http://www.ccam-va.com/university-members/

\(^{12}\) Examples like this add to the argument against considering this co-nominal adjectives as predicating over kinds: this example involves reference to ordinary objects.
counts as the chancellor of Germany). The discussion of the presidential examples will relate to distinctions within the social ontology.

3.2. Office and person levels of action

We distinguish in the ontology between two different sorts of acts: acts that occur at the level of a person, and acts that occur at an official level. Social offices are defined (in large part) by the rights, duties and official acts involved with the social role. Depending on the institutional norms and laws, presidents (for instance) might be empowered to wage war, negotiate treaties, sign bills into law, and so on. These are abilities that are reserved for the officeholder in the context of their official role. However, being abstract institutions, offices themselves cannot execute acts; they have no way to directly enact the physical doings that will count as the respective social types of action. Official acts must be implemented by concrete persons (and ultimately by the physical human beings who, for instance, move their hand when signing a bill).

3.3. Connections between levels

We introduce three relations that mediate between ontological levels. The first is the function INC “incumbent.” INC, when applied to an office, returns the person who is the incumbent at the given index. The second is the function IMPL “implementation.” IMPL applies to official-level acts and returns the person-level act that implements it. The third is a relation C-CONST “constitution under circumstance.” The inverse of IMPL, it relates a lower-level act to the higher-level acts it constitutes or counts as. C-CONST is not a function; the relation is transitive, and it also cannot be excluded that one act c-constitutes two different types of acts in parallel.

The C-CONST relation is an application of the notion of “level-generation” from Goldman (1970). Goldman, in developing his theory of action, argues that pairs of acts can be in an asymmetric relation with each other, such that one act is dependent on the other to generate it. Different acts in a generation, or C-CONST relations, correspond to different ways of assigning a given doing simultaneously to different types of action, at different levels in our ontology. For example, if the president, as an official action, signs a bill into law, this act is at the same time an act of moving their hand holding a pen, writing their name, signing a document, and investing its content with legal force. The actor of all this can do the first three acts as a private person (in different contexts), but the last one only in office. The official act is generated by the more basic acts. Crucially, acts level-generating or implementing each other must have the same agent (modulo the agent’s level-role) and the same temporal extension.

As a final step, we suppose that the usual thematic roles (AGENT, THEME and so on) are defined as functions over both official-level and personal-level acts, returning individuals who fill those roles in those events. The overall picture we get for our ontology is diagrammed in Figure 1.

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13 The notion of c-constitution is more general than Searle’s counts-as relation. The difference does not matter in this paper; see Goldman (1970: Ch. 2) for the broader notion.
3.4. Frames

Our analysis is developed using Frame Semantics (Petersen, 2007; Löbner, 2014, 2017), a theory regarding the structure of concepts based on the notion of frames in Barsalou (1992). Frames encapsulate lexical knowledge, world knowledge, or contextual knowledge in a single, unified format of representation. Thus, the frame theory we adopt is able to capture fine-grained semantic distinctions and not only features related to argument structure. A frame is a recursive attribute–value structure. An attribute is a function to capture a property, by assigning an individual entity in the underlying ontology a value for that attribute. For instance, an attribute COLOR would assign a color value to a visible object, PRICE a price to an economical good, BORDERS the borders to a region, or HEAD [OF STATE] the head of a state. Attributes have exactly one value for a given entity; they are functions, but the value may be described by a whole frame. This is what makes frames recursive structures. In a frame, one element is distinguished as representing the individual the whole frame describes.

Different styles for representing frames have emerged, such as the use of attribute–value matrices (AVMs), frame diagrams, and first-order logic. These representations are equivalent; frame diagrams can be transformed into AVMs or first-order predicate logical representation without loss of generality.\(^\text{14}\) We use a combination of frame diagrams and logical representations. For frame diagrams, nodes are represented with ovals or other graphic forms, with a double border for the central node, which represents the individual the whole frame describes. When relevant, nodes carry indices; they correspond to individual variables in the logical formulae. Nodes may also carry type labels; sometimes we will write the type-labels into the nodes. Arrows connecting nodes represent attributes, with the arrow pointing towards the value. Attribute arrows are always labeled. Composition of frames is modeled as unification (Carpenter 1992).

The use of frames in the chosen approach also involves ontological assumptions; the frame theory adopted is based on the assumption of an underlying global frame ontology which defines which attributes are available and admissible and which sorts and types of individuals are in the frame universe (Löbner, 2017: §2). The assumptions concerning social ontology are considered to be integrated in the frame-ontology. The functions INC and IMPL can be used as attributes for social-level offices (with a person incumbent) and social acts, respectively.

\(^{14}\) See Löbner (2017) for a general discussion.
4. Presidency, president, presidential, and presidency

4.1. The preside frame

As mentioned previously, we propose that the same concept is present in both president and presidential. The only differences concern the status of the frame elements. The preside frame (and thus the meaning of president and presidential) is based on the notion of an event of some person being the president of some organization. Crucially, this type of event is defined at a social level above the simple person level. We introduce the metalanguage predicate preside for the event of a presidency. For events of this type, there are three attributes (equatable to thematic roles) that are presently relevant. The first is ORG (for “organization”); it has as its value the organization that is presided over or headed. The second attribute is HEAD, which returns the one who heads the organization, roughly the agent of the presiding event. Finally, $\tau$ represents the temporal extension of the event. Figure 2 demonstrates the preside frame.

Our position is that certain role-denoting nominals such as president have an event in their lexical semantics that encompasses the official acts pertaining to that role. However, although we believe there is an eventive predicate in the lexical semantics of role nouns, this isn’t a commitment to role nouns being derived in any sense from verbs or there being a co-verb to the noun. What matters is the lexical semantics of the nouns themselves. Additional evidence is provided by the fact that role nouns can combine with adjectives like frequent and constant. This type of adjective has been argued to be licensed by event structure (Grimshaw, 1990). It’s possible to find attestations for constant and frequent modifying role nouns:

(17) I was a constant president of our class in my elementary [school] years...\(^{16}\)

(18) Another character whose life intertwines with the protagonists throughout the novel was Carter Harrison, a frequent mayor of Chicago.\(^{17}\)

\(^{15}\) That certain nouns can be supposed to have an event argument even if not morphologically derived from a verb was independently made in Larson (1998); he gives examples like daily newspaper, just king, stray bullet, and fast horse. See also Vendler (1967) for a predecessor of this proposal.

\(^{16}\) http://www.onlinejobs.ph/jobseekers/info/67905

\(^{17}\) http://www.storycirclebookreviews.org/reviews/gildedcage.shtml
4.2. President

We observe that the noun president can be used to refer to individuals at either the official level or the person-level of the ontology we have constructed—in other words, to refer to a role-individual or to the person inhabiting the role. The examples in (19a) and (19b) illustrate this, where (19a) has president referring at the official level, and (19b) at the person level.

(19) a. The president visited Canada as part of an official trip.
    b. #The president visited his mother as part of an official trip.

The frame in Figure 3 (represented using predicate logic in (20)) represents the core of the meaning of the noun president. Many attributes would have to be added to the value node of the head attribute for an adequate description of a president. The frame is essentially the frame for preside, except that the grammatical status of the nodes is specified and the central node is shifted to the president node $p$. This shift is what makes the frame represent the president (in the ‘office’ sense) rather than an event of ‘presiding.’

(20) \[ \text{president}_{office} = \lambda o \lambda t \lambda p \left[ p = \text{HEAD}(\text{preside}(e) \land \tau(e) = t \land \text{ORG}(e) = o) \right] \]

In lexical frames, we mark elements to be bound as arguments in syntax with rectangular boxes; in the corresponding predicate logic formula, their indices (essentially variables) receive lambda-binding. Referential nodes are surrounded by a star. The central node is marked by a double border. In Figure 3, the central node is the one for the president (in the ‘office’ sense) indexed with $p$, a referential node; the node $o$ is an argument node representing the relational argument of president (the organization). The node $t$ represents the time argument; for the sake of simplicity, president$_{office}$ is only defined for time periods of a full presidency. We supply the variable $e$ with an iota operator since we consider it adequate to assume that there can be only one “presiding” event at a given time for a given organization.

The concept for president in the ‘person’ reading is derived from the frame in Figure 4 (represented using predicate logic in (21)) by adding the attribute INC to node $p$ and shifting the central and referential node to its value node $i$. This extension comes for free as this attribute is defined for all office-entities provided the office is not vacant.

(21) \[ \text{president}_{person} = \lambda o \lambda t \lambda i \left[ i = \text{INC}(\text{HEAD}(\text{preside}(e) \land \tau(e) = t \land \text{ORG}(e) = o)) \right] \]
4.3. Presidential

The frame for *presidential* is essentially the same frame as for *president*\textsubscript{office}, its co-noun. The *presidential* frame is represented in Figure 5. This frame has no referential node, as it fits an adjective (and not noun) frame. It also has no argument nodes either, as *presidentially* cannot have its temporal or relational arguments syntactically specified. This feature implements the property of LA that they do not predicate.

4.4. Presidency

We use the same basic frame to model the meaning of *presidency*. This is a relational noun referring to the event of a presidency for an incumbent possessor argument. The result is depicted in Figure 6. The four frames developed for *president*\textsubscript{office}, *president*\textsubscript{person}, *presidential*, and *presidency* represent four variants of the same conceptual structure. Defining the central element invests the structure with a perspective concerning what element it is primarily related to. Investing certain elements with argument status concerns the way in which the structure is to be linked within the proposition frame for the whole sentence, while referential status amounts to a particular role the element plays when the proposition frame is related to the world.

5. Compositional analysis

5.1. Predication at a level

Some modifiers seem to be able to distinguish between official and personal senses, further supporting our claim that these levels are distinguished ontologically. As *president* is able to force a predication to be interpreted as official-level, while *privately* or as a private citizen forces a predication to be interpreted as personal-level. Both modifiers are acceptable if the sentence can be interpreted as either official-level or personal-level.

(22) a. As president/#Privately, the president vetoed the bill.
    b. Privately/#As president, the president combed their hair.
    c. As president/Privately, the president visited Canada.
We suppose that action at a level (e.g., action at the official-level or personal-level) requires event participants at that same level of the ontology. An event at the official-level, for instance, will require that both Agent and Theme of that event are also construed as being official-level entities. But then what are we to make of cases where entities seem to be mismatched in levels?

5.2. The official level and elaboration

When a DP with a role noun is the subject of the verb visit, it is possible to interpret the Theme as an individual at the official level of the social ontology (rather than the personal level). When the DP corresponding to the Theme inherently denotes at the official level, it’s quite clear what the Theme attribute of the visiting event should have as its value. However, a difficulty arises when the DP doesn’t inherently denote at the official level (e.g., that there is a mismatch of levels). For an illustration of this, consider (24). The name Trudeau naturally denotes the personal-level individual Justin Trudeau, but the sentence is most naturally interpreted as being an official visit between two heads of state (official-level individuals).

(24) The president visited Trudeau. (official)

How is it that Trudeau comes to denote the head-of-state-Trudeau rather than the private-citizen-Trudeau? Our solution is that the semantics of a term can be elaborated using a combination of world knowledge and the IMPL and INC mappings between levels. The example is fleshed out here in prose; the resulting frame is represented in Figure 7.

First, the Agent of the visiting: as the sentence asserts about an official-level visiting event, the Agent role of ‘visit_o’ must unify with an official-level agent. The value p of the HEAD attribute of the preside frame, the president, is suitable here. However, an official level Theme is also required. But, the name Trudeau denotes an entity at the personal level, not the official level. In order to have a Theme at the appropriate level, world knowledge and contextual knowledge is used to infer an individual at the official-level, such that the personal-level individual ‘Trudeau’ stands in an incumbency relation (via INC) with that individual (e.g., Justin Trudeau in the role of head of state). This is illustrated in the rightmost part of Figure 7. Finally, an official-level visit must be appropriately implemented by personal-level action (see section 3); we therefore need to project down from the ‘visit_o’ node to a corresponding personal-level action node ‘visit_p’. The Theme argument at this level is the personal-level ‘Trudeau.’ Note that ‘visit_p’ does not simply stand for a visit at the personal level. Being the implementation of an official visit, it stands for what the office incumbents do when one is paying an official visit to the other: they stage an official visit rather than visiting as private persons.
5.3. The personal level

Predications with president can also be situated at the personal level of the ontology, giving us a reading where something not necessarily official has occurred. For instance, if the internal argument of visit denotes an individual who does not have a (relevant) official-level role available for them, then the predication will be interpreted as applying at the personal level. An example of this is as in (25), where, because mothers do not normally have a relevant official role, the sentence is interpreted as it being a personal and not official visit. Of course, persons who are the incumbents of offices can also be visited as private citizens as well.

(25) a. The president visited his mother. (personal)  
b. (As a private citizen,) the president visited Trudeau. (personal)

In contrast to the analysis in the previous section, no elaboration of the official-level is necessary for visit in this case; the reason, to put it simply, is that an official-level visit did not occur. Predication at the personal-level can occur with president using INC to map from the office of the president to the incumbent. The frame in Figure 8 shows this.

5.4. Unification and presidential visit

Recall that the relational adjective presidential requires an official-level reading: for example, presidential visit only allows for an interpretation where the visit is part of the official sphere of duties related to the president. We model this by supposing that the concept for presidential only provides nodes at the official level—that is, no nodes related to the personal level of visit, such
as the incumbent, are provided by presidential. The consequence of this move is that unification of the visit concept with the concept for president can only happen at the official-level of our social ontology. While the DP the president provides for the possibility of reference at multiple levels, presidential only provides for reference at the official level. This means that presidential cannot be ambiguous with regard to which level is selected for predication.

This does not rule out other sources of ambiguity, however. One source of potential ambiguity is the event nominal visit itself. The concept for visit encodes (at least) two thematic roles, that of an Agent (the one doing the visiting) and that of a Theme (the one being visited). If neither role is saturated, with either syntactically explicit or contextually implicit arguments, we should expect presidential visit to be ambiguous, due to the possibility of the official-level president node being able to unify with either the Agent or the Theme thematic role. These possibilities are illustrated in (26) and (27). To explicate a bit, (26) shows the result of unifying the Agent node of the visit frame with the president (HEAD) node.

\[
\text{presidential visit} = \lambda e \exists x \left[ \text{visit}(e) \land \text{THEME}(e) = x \land \text{AGENT}(e) = \text{HEAD}(te'.\text{preside}(e')) \right]
\]

Example (28) shows the result of unifying the Theme node of the visit frame with president.

\[
\text{presidential visit} = \lambda e \exists x \left[ \text{visit}(e) \land \text{AGENT}(e) = x \land \text{THEME}(e) = \text{HEAD}(te'.\text{preside}(e')) \right]
\]

These multiple possibilities for unification predict that an ambiguity should manifest itself in examples like presidential visit, where the semantic representations include both an individual-denoting node and multiple thematic arguments. This seems to be borne out; corpus and search engine findings show speakers do seem to use presidential visit in a way that would be consistent with the analysis above, where the president can be the Agent (visitor) or Theme (visitee) of a visit. While uses of the Agent-related variant are abundant, (28) provides an attestation of the Theme-related use.\(^{18}\) Other role-denoting LAs also have non-Agent uses, such as in (29), where papal meeting can mean a meeting with the pope rather than by the pope.

(28) Will NBA champions continue to visit the White House under Donald Trump? One of the first players to make the presidential visit gives his opinion.\(^{19}\)

(29) Abuse survivor disputes removal from Vatican commission, seeks papal meeting.\(^{20}\)

Some accounts of RAs, such as Alexiadou and Stavrou (2011), treat them as essentially nominals, and argue that classificatory RAs syntactically saturate an external argument position. But, patterns such as those exemplified above are difficult to account for in those types of accounts, as the RA would need to be able to saturate both internal and external arguments (as the Theme

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\(^{18}\) For readers unacquainted with the tradition, members of the winning team of the NBA finals championship game typically visit the White House and meet with the American president.

\(^{19}\) [Link to article](http://www.golf.com/nba/2017/01/20/nba-white-house-visit-satch-sanders-celtics-jfk-donald-trump)

\(^{20}\) [Link to article](http://www.ncronline.org/news/accountability/abuse-survivor-disputes-removal-vatican-commission-seeks-papal-meeting)
argument is presumably an internal argument). In our analysis, the ability of RAs to be linked to either a Theme or an Agent role is a natural consequence of the machinery we use to analyze RAs. In this regard, we follow Arsenijevic et al. (2014), who also argue that the apparent argument-saturating behavior of RAs is only apparent and can be derived from the semantics of the construction (although our account does differ from theirs in crucial ways).

6. Conclusion

To conclude, we argue that the analysis of at least certain types of relational adjectives—our role-denoting relational adjectives or presidential-type adjectives—requires a richer semantic ontology than normally supposed. We develop an ontology that includes a social aspect to it, modeling a distinction between personal and social acts. Using this ontology we distinguish between levels of action that constitute or implement each other; our crucial example we develop is personal acts of visiting as implementations of official visitations. Roles are thus derived from the thematic roles available with events at different levels of the ontology.

The frame-based analysis we proposed differs from traditional approaches in formal semantics in a few relevant respects. First, frame representations allow for the type of decompositional strategy we pursued in our analysis, of mixing lexical, contextual, and world knowledge in a single representation. As the readings with president and presidential are driven in large part by context, modeling these different sources of knowledge in one place made stating their interaction relatively simple. Second, the use of unification as the basic mechanism of composition for frames allowed for a succinct way of capturing different meanings for presidential visit (e.g., a visit to or by a president), due to multiple possibilities for unification. And in a certain sense, our analysis is “intersective.” Unification of frames adds conditions to the single frames that are involved. In particular, unifying the noun frame with the LA frame adds conditions to be fulfilled by the referent of the noun. “Intersecting” the two frames in this way is more subtle and involved than plainly conjoining the two concepts.

Finally, this is a project very much in the spirit of “natural language metaphysics” as understood by Bach (1986) and Moltmann (2017). Our analysis is founded on a rich ontology, an ontology that includes social individuals and acts, and distinguishes between acts that implement or constitute each other, in the sense following Goldman (1970). From this ontology, we derive the notion of a social role; social roles are simply thematic roles of events at the official-level of our ontology, and linked to concrete persons on the personal-level via an incumbency relation. Official-level acts are similarly linked to concrete personal-level acts via an implementation relation. These levels in the ontology point towards natural language being sensitive towards acts of different levels of abstractness.

References


Focus constraints on ellipsis — An Unalternatives account
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Abstract This paper presents a new account of the generalization that focused elements cannot be elided, framed within Unalternative Semantics, a framework that does away with syntactic F-marking. We propose the mirror image of the generalization: what is elided cannot introduce alternatives. We implement this as a focus restriction in UAS and then go on to show how to account for MaxElide effects using the same technique, without making reference to any transderivational constraints.

Keywords: focus, ellipsis, alternative semantics, unalternative semantics, MaxElide, secondary focus.

1. Introduction

In this paper we discuss the interaction of focus and ellipsis in English in the Unalternative Semantics framework (UAS, see Büring 2015, 2016a, b). Consider examples (1) and (2), which illustrate the Focus–Ellipsis Generalization in (3).

(1) (Who was Kim going to kiss?) —
  a. ALEX.
  b. Kim was going to kiss ALEX.

(2) (What was Kim going to do?)
  a. Kim was going to kiss ALEX.
  b. Kiss ALEX.
  c. #ALEX.

(3) The Focus–Ellipsis Generalization (FEG): Focal elements cannot be elided.

FEG at first sounds like a truism: If ellipsis is the most radical form of deaccenting, it seems trivial that a focus—the accent bearer par excellence—could not be elided. But (2) already shows that things aren’t that simple: even though kiss need not bear a pitch accent in a VP focus answer like (2a)—and can in principle be elided, as in (1a)—such elision is impossible when the focus is a VP, as in (2c). Instead, only the non-focal subject and auxiliaries can be elided, as in (2b).

The straightforward move would seem to allude to a syntactic marking of focus. If VP were F-
marked in (2), but the object alone in (1), the ellipsis pattern would follow by equating ‘focal’ in (3) with ‘F-marked’. Note that on this view, the FEG provides an argument for syntactic focus marking: without F-markers or something like them, there is nothing in the structure for FEG (or the principles that account for it) to tell the difference between (1a) and (2c).

In this paper we argue against this. We show, in Section 2, how focusing and the FEG can be modelled without F-markers, based on the idea that ellipsis itself contributes to identifying (non-)focal material: what is elided cannot have (non-trivial) focus alternatives, as schematized in (4a) (where $\varepsilon$ is a marker for elision of its sister à la Merchant 2004).

(4) a. weaker hypothesis b. stronger hypothesis

Starting in Section 3 we explore a stronger version of this hypothesis, namely that ellipsis furthermore marks its remnant as focal, (4b). This stronger hypothesis turns out to give us a direct implementation of some MAXELIDE effects.

In Section 4 we examine some apparent problems regarding MAXELIDE and extraction and propose a solution to it that invokes SECONDARY FOCUS (SF), while Sections 5 and 6 elaborate on the further predictions we make regarding SF. Section 7 concludes. Data are either taken from previous literature, the Corpus of Contemporary American English (COCA, Davies 2008) or constructed by ourselves and judged by a native speaker of English.

2. Background

In this section we present the Unalternative Semantics framework. We show how it relates to more standard versions of focus semantics, and how the FEG can be captured in it without recourse to syntactic F-markers.

2.1. Unalternative Semantics

Unalternative Semantics (UAS) takes a syntactic tree annotated with metrical weights and directly derives the set of focus alternatives for each node. As such it rolls into one what is done by the rules for stress/accent-to-F, F-projection, and F-interpretation in frameworks that base Roothian alternative semantics on syntactic F-marking.

Crucially, UAS restricts focal alternatives at branching nodes only, in one of two ways. If the metrical weights among sisters are reversed from the default—where the default, for the time being, would be weak–strong—STRONG RESTRICTION applies.
(5) \( \wedge_s \underbrace{A_w} \) **STRONG RESTRICTION** (whenever s/w is reversed from the default): short: \( x^{\beta} \ C \)

A only allows alternatives that differ in B (=strong), but are the same in C (=weak)

Case (5) corresponds closely to the ‘traditional’ \( \wedge_{BF} \ C \): B gets to have non-trivial alternatives, those each get combined with the literal meaning of C to form A’s alternatives;\(^2\) we write this as \( x^{\beta} \ C \) (‘combine the ordinary meaning of C with any alternative to B, (except the ordinary meaning of B)’).

In case B and C show the default weak–strong pattern, a **WEAK RESTRICTION** is imposed.

(6) \( \wedge_w \underbrace{A_s} \) **WEAK RESTRICTION** (default w–s pattern): short: \( x^{\beta} \ C \)

A allows alternatives except those that differ in B (=weak), but are the same in C (=strong)

This case has no corresponding configuration in an F-marking framework: it contains all alternatives one would get from (7a), plus A’s literal meaning (‘alternative’ to (7b)), plus those alternatives to A that are not in the alternatives to (7c).

(7) a. \( \wedge_A \ C \) b. \( \wedge_A \ C \) c. \( \overbrace{A} \)

\( B \ C_F \) \( B \ C \) \( B_F \ C \)

We write this as \( x^{\beta} \ C \), to be read as: any alternative of type A, except those that replace B but not C (‘if the weak daughter is replaced, the strong one must be as well’).

Finally, restrictions from lower nodes **propagate**, so that for example A in (8a) (default weak–strong twice) allows for all alternatives except i) those that ‘replace’ B but not C, and ii) except those that replace D but not E (regardless of whether they replace B). Technically, the (weak) restriction introduced on C, \( x^{\beta} \ E \), propagates to A as \( y x^{\beta} \ E \) (‘no alternatives that replace D and keep E, regardless of whether they replace B’\(^3\)). A itself introduces the weak restriction \( y^{\beta} \ C \), so that the sum total restriction on A is ‘does not contain E, except if combined with B and D’.

(8b) gives a parallel derivation involving strong restriction.\(^4\)

(8) a. \( \wedge_w \underbrace{A_s} \) \( y^{\beta} \ C \) & \( y x^{\beta} \ E \equiv xy^{\beta} \ E \)

\( B \ C_S \) \( x^{\beta} \ E \)

b. \( \wedge_w \underbrace{A_s} \) \( y^{\beta} \ C \) & \( y x^{\beta} \ E \equiv y x^{\beta} \ E \)

\( B \ C_W \) \( x^{\beta} \ E \)

This much background should suffice to understand our proposal regarding ellipsis (see the appendix for more details). In fact, even though UAS knows four possible states with respect to

\(^2\)The only difference is that B’s literal meaning is not allowed to be used, a fact not relevant to the present paper.

\(^3\)Note that y here is not restricted, so it could be the literal meaning of B, or an alternative to it.

\(^4\)To aid reading, strong daughters are set in bold, and weak daughters that have undergone reversal are dotted.
introducing alternatives—1. must be replaced by alternatives (strong sister in reversed structure, SR) 2. must be unchanged in all alternatives (weak sister in reversed structure, SR), 3. may or may not be changed in the alternatives (strong sister in default structure, WR), and 4. may not be changed, unless its sister is changed, too (weak sister in default, WR)—as opposed to standard alternative semantics’ two (F or not), our final proposal for ellipsis merely requires 1. and 2., the classical ‘focal’ and ‘non-focal’. This means that the gist of our proposal should be understandable even without the details of UAS. The crucial theorems of UAS on which the proposal relies, though, require those details and are explicated in the appendix.

2.2. The Focus-Ellipsis Generalization within UAS

To make things more perspicuous, we assume a syntactic element $\varepsilon$ which marks the deletion/non-spell out of its sister constituent. $\varepsilon$ is borrowed from Merchant (2001), and assumed to be subject to contextual restrictions, roughly that the denotation of its sister must be contextually given (‘ellipsis under identity’), the exact formulation being irrelevant here.

Crucially, we put an additional restriction on $\varepsilon$, to the effect that its sister must not contain focal material (i.e. constituents that introduce non-trivial alternatives). In standard alternative semantics this would amount to requiring that in $[ \varepsilon B ]$, $B$ only has the trivial alternative, its literal meaning; indirectly this ensures that $B$ does not (bear or) dominate any F markers. We get the same effect in UAS requiring that the only alternative allowed for $[ \varepsilon B ]$ is (the literal meaning of) $B$, written as $B$. Take the term answer $ALEX$ from (1a) and (2) above, which we assume to be represented as in (9).

(9) $ALEX \varepsilon Kim$ was going to kiss $t_{ALEX}$

By virtue of $\varepsilon$, Kim was going to kiss is marked as non-focal, so all focus alternatives at the sentence level will be built around that property, i.e. Kim was going to kiss $x$. This makes (9) a good answer to the question ‘Who was Kim going to kiss?’, but not ‘What was Kim going to do?’. So the FEG is turned around: We do not prohibit deleting something focal, but rather mark something that might otherwise contain focal material as non-focal in the process of ellipsis (i.e. as a condition on the presence of $\varepsilon$).5

It bears pointing out that the problem with the term answer $ALEX$ to a VP-question as in (2c) is

\footnote{There is a complication here in that the question–answer condition (QAC) used with UAS in Büring (2015)—that A can answer Q if at least some answers in $[Q]$ are permitted as alternatives of A—actually fails to rule out an answer with only ‘Kim was going to kiss $x$’ alternatives as an answer to a VP question like ‘What was Kim going to do?’). The reason is that even an answer like Kim was going to kiss ALEX (‘VP focus’) does not have all propositions of the form ‘Kim was going to $Q$’ as possible focus alternatives; it lacks those in ‘Kim was going to Q kiss ALEX’ (for good reasons); therefore Büring (2015) relaxed the QAC so as to be content as long as some answers to the question are also permitted alternative of the answer, which, alas, is also the case if the permitted focus alternatives are just ‘Kim was going to kiss $x$’ or just ‘Kim was going to R ALEX’. The correct version of QAC should be one that does not mind if, say, an answer to ‘What did Kim do?’ lacks some of the ‘Kim Q’ propositions as alternatives, but does mind if it only allows alternatives that are of the sort ‘Kim kiss $x$’ or ‘Kim R ALEX’. But since QAC does not know about the ‘form’ of propositions, it is unclear to us at this point how to best state such a condition, so we leave this for another occasion.}
not in general accounted for by demanding that the complement of $\epsilon$ is given (as is standardly assumed, e.g. in Merchant 2001). To see that, consider (10):

(10) (Kim was going to call me, but then my phone went dead. What is Kim going to do now?) — *(call) ALEX

In (10) ‘Kim was going to call’ is made contextually salient, so the elided part of (9), Kim is going to call, is given. Yet, (10) is no better than (2c). We conclude that the oddness of (2c), like that of (10), is not attributable to eliding something non-given (Kim called in (2c)); rather, we submit, the problem is that in both cases call is marked as non-focal (by virtue of being elided), although it is part of the focus. The standard treatment of $\epsilon$ alone thus does not derive the FEG.

On the treatment just proposed, the restriction imposed by $\epsilon$ is different from both Weak and Strong Restriction; it is just the weak daughter condition of Strong Restriction (‘can’t be focal’), with out its relational counterpart (‘must be focal’). While this is certainly possible to do in UAS, it may be worth exploring the idea that $\epsilon$ does in fact impose a Strong Restriction: not only must the elided part be non-focal, its sister (or, counting $\epsilon$ itself: its aunt) must be focal, as schematized in (4b) above.

3. The remnant must be focal

If $\epsilon$ imposes a SR, this means that the immediate remnant of an ellipsis must be focal. This seems generally on the right track, and in particular, it derives a number of so-called MaxElide effects, exemplified in (11).

(11) a. *John saw something, but we don’t know WHAT he did.
   b. John saw something, but we don’t know WHAT.

The definition of MaxElide, as stated originally in Merchant (2008) is given in (12).

(12) MaxElide: Let XP be an elided constituent containing an A’-trace. Let YP be a possible target for ellipsis. YP must not properly contain XP. (Merchant 2008: p.141)

To a first approximation, MaxElide means that a smaller ellipsis like VP in (11a) is ungrammatical in a context where a bigger ellipsis, like TP in (11b), is possible. Using $\epsilon$ with a Strong Restriction, as suggested above, the two competing structures are given in (13).6
In (13a) *he needs to be focal, by $\varepsilon$, and there should be a contrastive target of the form ‘somebody else saw something’, which there isn’t. Furthermore, what fails to be marked as focal in (13a), though it clearly is the element contrasting with something.

In (13b), on the other hand, what is marked as focal, and everything else as background, which exactly matches the context in (11). So using a strong restriction with $\varepsilon$ not just makes sure that nothing focal is elided (which is the case in both (13a) and (13b)), but also that the final non-elided remnant is itself focal. This captures the basic MAXELIDE effect. What is more, it does so without invoking a transderivational constraint, which most other accounts of MAXELIDE effects we know of do.

4. Apparent Problem: MAXELIDE and Extraction

What our story so far does not capture is that MAXELIDE effects appear to be restricted to cases in which the ellipsis site contains a trace. Thus in (14), which does not involve extraction, both small (lower VP) and maximal (higher VP) ellipsis are equally acceptable, apparently ignoring MAXELIDE.

Note that unlike in our earlier trees, $\varepsilon$ in (13) is sitting on preterminal nodes—T and C, respectively—rather than being adjoined; as a consequence, the SR does no longer regard nodes, but aunt–niece pairs (here: SpecT and VP/SpecC and TP). We believe that this is at least an option (though it wouldn’t make a difference in (13), since there $\varepsilon$ could also just adjoin to $C/T$), as English in some cases allows for a non-focal head between the ellipsis site and the closest focus. This is shown in (i), where an $\varepsilon$ adjoined right above the ellipsis site, as in (ib), would wrongly force did to be focal.

We are not concerned with what categories can and cannot be elided in English in general. See e.g. Miller and Pullum (2013) for further information.

7See Messick and Thoms (2016) and Griffiths (2017) for different accounts of deriving MAXELIDE effects.
(14) John said Mary likes Peter.   a. No, BILL said she *does*.   b. No, BILL did.

According to what we said so far, (14a) should only be possible if *does* (or *she*) were focal. But is it? Clearly it does not bear the nuclear pitch accent, which in both cases is on Bill (as one would expect). We submit, however, that *does* is a Secondary Focus (SF), i.e. a focus that is contained in the background of the main focus (*BILL*). As in (14a), we indicate a SF by boldface, reflecting that it is marked by stress, but not accented (which would be indicated by capitals). The structures for (14a) and (14b) are then as in (15a) and (15b), respectively.

(15) a. TP
    |  
    +---+---
    |    |   
    +---+---
      T  VP
      |     
      +----
        CP
        |    
        +---
          TP
          |  
          +----
            C
            | 
            +----
              *   
              "she"
              did
              "like Peter"

Section 6 below provides independent evidence that, indeed, the final remnant before an ellipsis is always focused, even when not accented.

But for now we want to make sure that the introduction of SFi as a general possibility does not throw out the proverbial baby with the bathwater: If a SF can generally obscure the effect of MAXELIDE in this way, why are there unacceptable cases at all? That is to say, why can we not claim that (13a) also contains a SF on *did* or *he*, as in (16)?

(16) John saw something, but we don’t know…
just a VP; rather one has to find an antecedent matching a **Parallelism Domain**, which includes, in addition to the ellipsis site, the binders for the variable. For example, while \([v_{\text{plikes Peter}}]\) in (14a)/(15a) can directly be licensed by \([v_{\text{plikes Peter}}]\) in the first sentence (their semantic identity can be established at the VP level), \([v_{\text{see t\_what}}]\) in (16) cannot, because it contains an unbound trace (roughly, we do not know its denotation, and hence cannot establish synonymy with any antecedent). Instead a parallelism domain that includes the antecedent, *what*, is required, i.e. the entire CP. In (15), on the other hand, any constituent containing the ellipsis site (and even the ellipsis site itself) is a potential PD (as there are no variables waiting to be bound).

Takahashi and Fox (2005) then cash out **MaxElide** as ‘Delete the biggest deletable constituent within a PD’. For example, since the minimal PD in (16) is CP, ellipsis must delete TP, not just VP. The minimal PD in (15a), on the other hand, is the elided VP itself (since there are no unbound traces within it), within which, trivially, that VP is the biggest deletable constituent. If one picks the matrix VP or TP instead, the biggest deletable constituent within *that* is the matrix VP. So still, for any given PD, the ellipsis site is maximal, it’s just that there are various choices of PD. Where there is a trace involved, however, choices are effectively restricted to a domain containing at least the antecedent; (17) below illustrates again what rules out smaller PDs for such a case, here (16).

(17) John saw something, but we don’t know
   a. *what he did [see t\_what]_{\text{PD}}.*  
      PD contains trace, but not antecedent
   b. *[what he did see t\_what]_{\text{PD}}.*  
      PD ok, ellipsis not maximal in PD
   c. *[what he did see t\_what]_{\text{PD}}.*  
      PD contains antecedent, ellipsis maximal

In our proposal, the role of Takahashi & Fox’s PD is roughly played by the **Domain of the Secondary Focus**, i.e. the domain that consists of the secondary focus and its background. Like Takahashi & Fox’s PD, the domain of a focus is in principle free (so long as it contains the focus, of course), provided it does not contain unbound variables. As a consequence, if the SF c-commands a trace, its domain must include the antecedent of that trace, again just like Takahashi & Fox’s PD.

Crucially, and unlike in the case of Takahashi & Fox’s PD, there is also an upper limit on the choice of the domain for a SF: it cannot include the main focus. This is a consequence of the UAS mechanism, as we demonstrate in the appendix. For now, we simply state that the choice of domain for the SF is limited: big enough to contain the antecedent of a trace (if there is one), but not including the main focus.

Importantly, these two conditions cannot possibly both be met in case the extractee is itself the main focus of a sentence. For example, in (16), repeated in (18a), the domain of the SF *he* has to include *what* so as to have the VP internal trace bound, and at the same time must *not* include *what*, since that is the main focus. This dilemma will present itself whenever the extractee is the main focus; in other words, there can be no SF in such cases, and hence no non-maximal ellipsis.
In a non-extraction case like (15a), repeated in (18b), no such problem arises: Since there is no trace waiting to be bound, the domain of the SF on does can be as small as (embedded) TP, CP or (higher) VP, which all exclude the main focus Bill. We thus predict that—other constraints on the choice of the focus domain notwithstanding—ellipsis size is flexible in these cases.

This concludes our derivation of MaxEilde effects and their (apparent, see Section 6) absence in non-extraction contexts. In the next Section we will discuss in more detail the interaction between SF and extraction. But first, let us take stock: the basic MaxEilde effect is written into the semantics of ellipsis itself, i.e. once $\varepsilon$/ellipsis is used, not only does the elided part need to be non-focal, but the nearest remnant must be focal. No transderivational constraints are needed (cf. ‘biggest deletable’), it’s just that any smaller ellipsis would wrongly mark something as focal that ought to be in the background. Furthermore there is now a reason why the size of what Takahashi and Fox (2005) call P(arallelim) D(omain) relates to the minimum ellipsis size: The minimal PD is the domain in which no S(econdary) F(oci) can occur. Lastly, our proposal directly answers the question why, unlike similar principles like Maximize Presuppositions (Heim 1991), MaxEilde does not penalize the complete absence of ellipsis even where possible, that is, why the urge to elide as much as possible is only activated once some ellipsis has taken place: the alleged ‘principle’ MaxEilde is just a consequence of the conditions that come with $\varepsilon$; no $\varepsilon$—no MaxEilde effect.

5. More Complex Interactions Between Ellipsis and Extraction

So far, we have paid attention only to configurations in which the phrase extracted from the elided VP was itself the primary focus. However, the generalization we have derived is a different one: that MaxEilde effects will be observed unless the primary focus is higher than the extractee. This section will look at the two sides of this prediction that were not discussed so far: cases in which the primary focus is higher than the extractee, and cases in which it is lower.
5.1. Focus Below the Extractee

These cases have actually been discussed in the literature a lot: A focus below the extractee *forces* ellipsis to be smaller.\(^8\)

\[(19)\]
\begin{enumerate}[a.]
\item I think YOU should ride the TALLEST camel, but I don’t know which one PHIL should.
\item I don’t know which puppy you should agree to adopt, but I know which one you should NOT.
\end{enumerate}

In existing accounts this is because a focus renders any constituent containing it undeletable. On our account, basically the same holds: As soon as a constituent is not given, it cannot be below \(\epsilon\). Another prediction we make for these cases is that ellipsis *does* have to be maximal below that focus. We share this prediction with Takahashi and Fox (2005), who contrast (19b) with the unacceptable (20), in which the ellipsis ends unnecessarily far below the focused *not*.

\[(20)\] *I don’t know which puppy you should agree to adopt, but I know which one you should NOT agree to.*

In contradistinction to that, Griffiths (2017) claims that a focus underneath the extractee basically neutralizes MAXELIDE, providing examples such as those in (21) (his (13)).

\[(21)\]
\begin{enumerate}[a.]
\item I know who MARY thinks he’ll kiss and also who SUE thinks he will.
\item I know who BILL hopes to kiss and also who BOB hopes to.
\end{enumerate}

Our account clearly predicts these to be ungrammatical, so to the extent that Griffiths’ judgements are shared\(^9\), more needs to be said here. On the other hand, we correctly predict the contrast between (19b) and (20), which is surprising given Griffiths’ account.

5.2. Focus above the Extractee

We assume that no MAXELIDE effects will be observed if there can be a (variable-free) focus domain below the main focus. So far we looked at cases in which the main focus was an element extracted from the ellipsis site, so that the *de facto* there could be no MAXELIDE obviations in structures with extraction.

But in principle, an extractee need not be focused, in which case we predict that MAXELIDE obviations are possible. A pertinent example is given in (22) (33) from Merchant 2008):

\[(22)\] ??Ben knows who she invited, but Charlie DOESN’T know who she did.

\(^8\)Examples (48) from Schuyler (2001) and (32) from Takahashi and Fox (2005).

\(^9\)Not all speakers accept these examples, so there seems to be a fair amount of inter-speaker variation. Furthermore, some speakers find (21b) worse than (21a), we leave this open for now.
According to our proposal, if *did* in (22) is a SF, it could take either the *who* clause or the VP headed by *know* (i.e. anything below the sentential focus *doesn’t* and above the extractee) as its focus domain (FD). In either case, there shouldn’t be a problem and the resulting sentence is predicted to be grammatical. (23) illustrates the case where the *who* clause is the FD of *did*:

(23)  

DOESN’T know *who* she *did* invited *t*<sub>wh</sub>  

domain of SF *did*  

The literature partly bears out this prediction in that Merchant (2008) judges (22) better than ‘regular’ MAXELIDE violations—i.e. ones in which the extractee is focused—such as (24) (his (30)).

(24)  

*I know we invited SOMEone, but I can’t remember WHO we did.*

But (22) is still judged as degraded, which is not predicted by what we said so far. We are not sure what the cause of this degradation is; there are reasons to believe, though, that it is unrelated to the MAXELIDE effect. Observe that Merchant judges (22) on a par with (25), which, notably, involves extraction of an adjunct, *when*.

(25)  

??Abby knew when he had quit, but Beth DIDN’T know when he had.

Crucially, adjunct extraction generally does not lead to MAXELIDE effects at all (as they do not involve VP internal traces, cf. again (12)), as has been observed in the literature, (26) (ex. (16a) from Schuyler 2001), and indeed we found examples of this kind in the COCA corpus (Davies 2008), e.g. (27).  

(26)  

*I think you should adopt one of these puppies, but I don’t know WHEN you should.*

(27)  

a. Sean: And the airline was not willing or forthcoming today, General McInerney, with any information about why he stopped his training back in 2009. That’s somewhat of a puzzle, right?  

b. General McInerney: It’s very puzzling, Sean. **We have to do a deep dive into that to see why he did.** Did he suffer depression?

Likewise (25)’s counter-part in (28) seems impeccable.

(28)  

Abby knew that he had quit, but not WHEN he had.

Based on this, it seems justified to assume that (22) and (25) are degraded for the same reason, and that, in the light of (25), that reason should crucially not be related to the explanation for MAXELIDE effects, but something independent. While of course we would like to know what that something is, we will have to leave that question for another occasion.  

10 The context is provided in (27a), while the relevant sentence is marked in bold in (27b).  
11 The crucial difference between (28) and (25) appears to be that the main focus has ‘moved’ from the *wh*-word to something further to the left, so that the *wh*-word itself becomes part of the background, as schematized in (i).  

(i)  

MAIN FOCUS…*wh*-phrase…*aux*  

/ *twh*  

/
predicts—correctly, as we just argued—that (22), like (25), does not show a \textsc{MaxElide} effect, and that both are of equal acceptability, which is significantly higher than ‘classic’ \textsc{MaxElide} violations.

6. Effects of SF

In this Section we motivate the assumption that cases of non-maximal ellipsis indeed involve a S(secondary) F(ocus). Or put differently, that ellipsis is really always maximal, once we consider SF, and as predicted by our claim that ellipsis itself marks its closest remnant as focal.

For this, we need to look at cases that do not involve extraction from the ellipsis site, such as those in (29) ((35) from Merchant 2008: with indication of accents added).

\begin{align*}
\text{(29) } & \quad \text{a. Ben knows that she invited Klaus, but her father DOESN’T} \\
& \quad \text{b. Ben knows that she invited Klaus, but her father DOESN’T know that she did.}
\end{align*}

According to existing accounts of \textsc{MaxElide} effects, the choice between (29a) and (29b) is optional, as the choice of ellipsis size is in general where no extraction from within VP is involved. On the present proposal, (29b) must involve a SF on \textit{did}, that is: it emphasizes that her father assumes that she \textit{didn’t} invite Klaus. While this seems consistent with our intuition, it turns out difficult to really pinpoint these aspects of meanings. In particular, we would like to see cases in which a non-maximal ellipsis is unacceptable because its remnant cannot be focal for independent reasons.

To do so, we will concentrate on associated foci to demonstrate the connection between ellipsis size and focus interpretation. For an illustration consider (30).

\begin{align*}
\text{(30) } & \quad \text{A: Bob will only tell me WHERE he’s going (not when).} \\
& \quad \text{B: (i) I wonder WHY.} \\
& \quad \text{(ii) *I wonder WHY he will only tell you.} \\
& \quad \text{(iii) I wonder WHY he will only tell you where.}
\end{align*}

By inserting \textit{only} below the remnant of the higher sluice, we can quite reliably control the position of the SF in the small ellipsis cases, here on \textit{where}. (30-ii) and (30-iii) set our baseline in that they show that, once \textit{only} is overt, its associate must be, too, where both follow the sentential focus and are therefore deaccented, resulting in a rather small ellipsis.\footnote{Note that the extraction in (30) is from the non-elided VP headed by \textit{(only) tell}, so a proponent of the ‘classical’ \textsc{MaxElide} approaches could claim that (30-iii) is unsurprising, given that in non-extraction cases the choice of ellipsis size is free anyway. But our, stronger, claim is that in fact, the small ellipsis in (30-iii) is only possible if \textit{where} is a SF. To bring home that point, we suspect that the resulting configuration, then, involves two secondary foci, one on \textit{had}, one on \textit{when}, both embedded under the main focus \textit{didn’t}, which might simply be too hard to contextualize.}

We suspect that the resulting configuration, then, involves two secondary foci, one on \textit{had}, one on \textit{when}, both embedded under the main focus \textit{didn’t}, which might simply be too hard to contextualize.

This generalization—that (secondary) foci may be deleted only if the element they associate with is deleted, too (see also Han and Romero 2004: note 15. p.199, and Büring, 2015:note 23)—is actually derived by our account: the focus sensitive element ‘retrieves’ the focus, i.e. allows the alternatives to be reset.
we need to look at (30)’s minimal cousin (31).

(31)  A: Bob will only tell ME where he’s going.
     B: (i) I wonder WHY.
         (ii) I wonder WHY he will only tell you.
         (iii) *I wonder WHY he will only tell you where.

First off, note that (31-ii) is acceptable in this context (unlike (30-ii) in (30)), because only associates with the overt (and by hypothesis SF marked) you. More importantly, (31-iii) is unaccept able here (contrasting with (30-iii)); its only reading is one in which only associates with where (‘where, but not when’, just as in (30)), which is infelicitous in this context as it differs from the main focus in A’s utterance in (31). This is exactly the evidence we are after: for the ellipsis to be non-maximal, the final remnant must be (secondarily) focal.

Additionally, (30) and (31) between them show that previous accounts of MaxElide-like effects are incomplete in several ways. First, (31-iii) should not fall under the purview of MaxElide to begin with, since it does not involve extraction from the ellipsis site at all. On our account, all ellipsis is subject to MaxElide—or more precisely: marks the final remnant as focal—, so effects like in (30)/(31) are predicted.

Second, this effect cannot be due to competition between ellipses of different sizes. The only elliptical competitor in (30) and (31) alike is (B-i); (31-ii) (like (30-ii)) does not involve ellipsis, but null-complement anaphora. But if (30-i) were to block (31-iii), it should do so in (30-iii) as well. On our account, (30-iii) is grammatical because where can be a SF in the context of (30), and (31-iii) is ungrammatical because it cannot—the SF must be you, not where. There is no competition involved.

In fact, (31-iii) actually is the maximal ellipsis structure that contains only and its associated focus you. So a version of MaxElide that claims (30-iii) to be grammatical because it is the biggest ellipsis excluding where—the focus associated with only—would have to do the same for (31-iii); the next bigger ellipsis, the VP headed by tell, would fatally include you. Again, the present account has no trouble with this since it does not invoke competition (of ellipses or otherwise) at all.

13Even if you think that null-complement anaphora is a form of ellipsis, it still should not compete, lest (ia) be blocked by (ib).
   (i) a. Mary has a hunch why Bob bailed, and Sue even KNOWS why.
          b. Mary has a hunch why Bob bailed, and Sue even KNOWS.

14Throughout this Section we have ignored the option of deleting the middle VP, i.e. a reply like I wonder why he will in (30)/(31). These sound bad in either context, as predicted. However, it seems generally hard to elide a VP with initial only; that is to say, (i) seems to mean that Steve will tell me where he (Steve) is going, not that he will only tell me.
   (i) Bob will only tell ME where he’s going, and Steve will, too.
Whatever the reason for this, it may explain independently why I wonder WHY he will sounds odd in our examples, so we did not consider it in the paradigms.
7. Conclusion

In this paper we have put forward an account of the generalization that focus cannot be elided, without making reference to syntactic F-markers. We propose that ellipsis itself imposes a restriction on the available (non-trivial) focus alternatives: Whenever ellipsis applies, the elided part cannot introduce alternatives. In a second step we proposed that ellipsis imposes an additional focus restriction to the effect that the final remnant is itself focal. This was shown to capture so-called \textsc{maxelide} effects, and to do so without using transderivational constraints.

Crucially our proposal assumes that this marking occurs with any instance of ellipsis, not just those containing traces. Cases in which smaller ellipses are permitted are analyzed as involving a secondary focus on the final remnant as well. This assumption was motivated using examples with associated second occurrence foci in non-maximal ellipses. On the resulting picture there is no \textsc{maxelide} principle, rather the effect follows, like the ban on deleting focal material, from our general modelling of ellipsis, without F-markers or any kind of competition-based principles.

Appendix: Secondary Focus in UAS

A SF results when a focal constituent, though locally strong, ends up within a weak branch higher up in the tree. To make this more perspicuous we follow Rooth (1992) and mark the domain of a focus by a \textsc{squiggle operator} $\sim$ adjoined to that domain; some examples are given in (32).

\begin{center}
\begin{tabular}{ccc}
  (32) & a. & b. & c. \\
  & TP & TP & TP \\
  & Kim & Kim & Kim \\
  & T & T & T \\
  & VP2 & VP2 & VP2 \\
  & $\sim C$ & $\sim C$ & $\sim C$ \\
  & VP1 & VP1 & VP1 \\
  & yesterday & yesterday & yesterday \\
  & SAW & SAW & SAW \\
  & DP & DP & DP \\
  & the piano & the piano & the piano \\
  \end{tabular}
\end{center}

The squiggle operator \textsc{retrieves} the focus, which—just like in Rooth (1992)—involves two things: First, it checks that the value of $C$ (a covert pronoun, the focal target) is allowed as a focus alternative to the domain, i.e. compatible with the restrictions accumulated so far (otherwise the structure is undefined). If so, it, second, optionally \textsc{resets} the focus, i.e. sets the only possible alternative to the domain to be its literal meaning.

As detailed in Büring (2015), the resetting is crucial for the treatment of secondary foci. A typical SF configuration is \textsc{second occurrence focus}, where the domain of one focus...
(the secondary) is included in the background of, and follows, the main, focus, as in (33a).

(33)  a. (The kids only skimmed the book.) Even JOHN only **skimmed** the book.

   b.  
   
   \[
   \begin{array}{c}
   \text{DP} \\
   \text{TP} \\
   \text{VP} \\
   \text{T} \\
   \text{DP} \\
   \text{PA}
   \end{array}
   \]

(33b) gives the full representation of the second clause, including a metrical grid compatible with the weights in the tree, and the resulting accent placement. **skimmed** is focal, as its mother node VP has undergone prosodic reversal, and the entire T is in the background of the focal **even John**, whose mother TP likewise is reversed.

The crucial generalization that follows in such a configuration is that the focus on the SF **skimmed** has to be retrieved below the higher focus; put differently, the domain of the focal **skimmed** may be at most as big as T. As Büring (2015), following Büring (2015), shows, this generalization is born out by the facts around second occurrence focus.

The ellipsis configurations we argued for in this paper are structurally parallel to SOF, see for example (34): **does** is a SF, marked in this case not by prosodic reversal, but by ellipsis/ε, whose domain is in the background of the main focus on **Bill** (marked by prosodic reversal on TP).

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15Every Second Occurrence Focus is a Secondary Focus, but not necessarily *vice versa*. The domain of a SOF, as the name suggests, needs to have a more or less verbatim antecedent, such as the first clause in (33a). A Secondary Focus is simply a focus whose domain is in the background of another focus. If there can be non-anaphoric focus domains, as we assume there can be, a SF need not have an antecedent.
In (34) we also indicated the restrictions on focus alternatives imposed on the various nodes. Using those, we can now show that the restriction that SF needs to be retrieved and reset ‘before’ the main focus, indeed just follows from the general UAS system.

The lower $\bar{T}$ marks $\text{do}$ as focal (by ellipsis), a restriction that is propagated up. All nodes above $\bar{T}$ and below the root have default weak–strong patterns and add rather trivial weak restrictions: they may or may not be focal. The only alternative to $\text{do(es)}$, we assume, is ‘does not’, so $\bar{T}$, TP and higher VP all require the focus alternatives to be about not liking Peter.

Fatally, the restriction originating with $\varepsilon$—that alternatives must involve $\text{not}$ liking Peter—clashes with the strong restriction imposed by the prosodic reversal of the root TP, which requires ‘said she likes Peter’ to be background, i.e. be constant in any alternative. As indicated in the underlined part on the top line, these two are incompatible (one wants ‘do’es’ one wants ‘doesn’t’).

In such a configuration the SF needs to be retrieved before the higher focus comes along. This is shown in (35), where $\circledR$ marks the node at which the permitted focus alternatives are reset to the literal meaning.
Focus constraints on ellipsis

When the focus is retrieved by \( \sim C \) (by juxtaposing ‘she does like Peter’ with the value of \( C \) ‘she doesn’t like Peter’), it is reset, so TP only has the trivial alternative. That in turn is propagated in the usual way until it meets the SR at the root level. This time the local strong restriction at the root and the propagated \( y \) said she does like Peter are compatible (in fact, the former simply subsumes the latter).

Finally, and crucially, a focus cannot be retrieved in a domain that contains unbound variables, (36a) and, as we just saw, it has to be retrieved before the ‘next’ focus. So if the binder to a variable in the focus domain is the next focus up, retrieval is impossible, and the structure crashes, (36b). As a consequence, there can be no SF in such configurations and maximal ellipsis up to the main focus is obligatory, (36c).
References


Factors licensing embedded present tense in speech reports
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Abstract. According to Ogihara (1995), the usage of the embedded present in a speech report such as *John said that Mary is in the room* is restricted by the cause of John’s belief (the state that made John think that Mary is in the room): the present tense can be used only if this cause still holds at the time that *John said that Mary is in the room* is uttered. This paper presents experimental evidence demonstrating that this is only one of the factors that licenses a felicitous usage of the embedded present tense. In particular, we show that the cause of belief still holding is not a necessary condition, and identify two additional, sufficient (but not necessary) factors: in cases of false belief, who is aware of the falsity of the belief and duration of the reported state. While these factors are independent, they collectively support the idea that the present tense encodes ‘current relevance’, even in embedded contexts (e.g. Costa 1972; McGilvray 1974). This gives rise to the question of how we can derive ‘current relevance’ and, in particular, whether previous analyses of the embedded present tense are adequately equipped to do so.

Keywords: tense, speech reports, double access, experiments.

1. Introduction: present under past

The question this paper addresses is the following: when can we use a present tense in the complement of a past tense speech report? An example of such a construction is in (1):

(1) John said that Mary is in the room.

Ogihara (1995) claimed that the truth of the complement at the actual utterance time *n* (the time when (1) is uttered) is not a prerequisite for the use of an embedded present tense. What matters instead is the cause of the belief (the state that made John think that Mary is in the room, e.g. the presence of someone who looks like Mary). More precisely, Ogihara’s observation was that the present tense can only be used if this cause still holds at *n*. We refer to this as the KEY OBSERVATION since it has motivated various analyses of embedded tense (e.g. Abusch 1988, 1997; Ogihara 1995; Heim 1994). Recently, however, the KEY OBSERVATION has been called into question by Klecha (2015), who comes with the following scenario:

(2) Mary puts a balloon under her shirt. John then observes her in this state, and then says to everyone: ‘Mary is pregnant!’ Later that day, Mary takes the balloon out from under her shirt and pops it. Bill, aware of everything that happened, says to Mary: ‘(Earlier today,) John told everyone that you’re pregnant.’

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1We would like to thank the participants of Sinn und Bedeutung 22, XPrag 2017 and the Oslo Theoretical Linguistics Seminar for their comments. The research for this paper is supported by the EU under FP7, ERC Starting Grant 338421-PERSPECTIVE (Bary).
In this scenario, the cause of John’s belief that Mary is pregnant, i.e. the state of the balloon under her shirt, is absent by the time of Bill’s report. Nevertheless, the present tense is acceptable, suggesting that the KEY OBSERVATION is empirically inadequate.

This difference leads us to ask what exactly it is that licenses the embedded present tense and whether, if it turns out that more than one factor plays a role, this bundle of factors are unified by, and are the instantiation of, an underlying factor. To make headway in addressing these questions, we conducted two experiments (a rating task and a forced choice task) that manipulate such factors and aim to precisify the empirical basis for the use of the embedded present tense. Our starting point is in the comparison of the minimal differences between Ogihara’s and Klecha’s scenarios, which give rise to the factors we manipulate: (i) the choice of a particular embedding verb of reporting, (ii) in cases that involve false belief, who is aware of the falsity of the belief, and (iii) the duration of the reported state. Our experimental findings indicate that while (i) does not appear to have an influence, factors (ii) and (iii) do. We propose that—along with the KEY OBSERVATION—(ii) and (iii) collectively support the idea of ‘current relevance’ (Costa 1972; McGilvray 1974), thereby giving rise to the question of whether and how previous analyses of the embedded present tense are adequately equipped to derive ‘current relevance’.

The structure of the paper is as follows: In section 2 we further outline the historical and theoretical background to our experiments. In particular, we discuss the scenarios that led Ogihara to his KEY OBSERVATION, as well as Klecha’s example noted above. In comparing the data, we motivate two experiments, which we discuss in section 3. Finally, in section 4 we discuss the consequences of our experiments for previous analyses of the embedded present tense.

2. Background: Ogihara’s key observation and Klecha’s counterexample

Much research in the past decades has been devoted to providing adequate felicity conditions for the use of the present tense in past tense speech reports. When comparing (1) with its past tense counterpart in (3), the idea has been since the 70s that the embedded present tense imports additional information (e.g. Smith 1978):

(1) John said that Mary is in the room.

(3) John said that Mary was in the room.

While both the present and past tense lead to an inference in which according to John, Mary was in the room at the time that John locates himself at the time of his utterance, only the embedded present tense imposes a requirement about the actual utterance time $n$. This additional requirement has lead to the name double access (Enc 1987), describing an interpretation of (1) that involves reference to two times (the time John locates himself and the actual utterance time $n$).

2See Klecha, this volume for discussion.
In the nineties, Ogihara and Abusch independently tried to make clearer what exactly it is that has to hold at the actual utterance time for the present tense to be felicitous. Ogihara (1995) considers various contexts for (1):

(4) John and Bill are looking into a room. Sue is in the room.
John (near-sighted): ‘Look! Mary is in the room.’
Bill: ‘What are you talking about? That’s Sue, not Mary.’
a. John: ‘I’m sure that’s Mary.’
One minute later, Kent joins them. Sue is still in the room.
Bill (to Kent): ‘John said that Mary is in the room. But that’s not true. The one that is in the room is Sue.’
b. John: ‘Yeah. You’re right. That’s Sue.’
One minute later, Kent joins them. Sue is still in the room.
Bill (to Kent): ‘John said that Mary is in the room.’
c. John: ‘I’m sure that’s Mary.’
Sue leaves the room. One minute later, Kent joins them.
Bill (to Kent): # ‘John said that Mary is in the room.’

On the basis of (4a), Ogihara concludes that the truth of the complement at the actual utterance time is not a prerequisite for the use of a present tense: Mary is not in the room, but still a present tense in the complement is acceptable. Moreover, based on (4b), Ogihara argues that it also doesn’t matter whether the reported speaker (John) has found out the truth of the complement at some point after his utterance. By the time of the report, John no longer believes that Mary is in the room, but again the present is still acceptable. Comparing (4a) and (4b) (where Sue is still in the room) with (4c) (where Sue has left), Ogihara concludes that if the state that made John think that Mary is in the room still holds at the actual utterance time \( n \), then we can use the present tense. Otherwise, we cannot. As mentioned in section 1, we call this the KEY OBSERVATION.

Without going into too much detail, let us say a bit on the formal-semantic implementation of this observation, which we come back to in section 4. In Ogihara’s words, the truth conditions of (1) are as follows: (1) is true iff there exists a state \( s \) at the actual utterance time \( n \) such that John talks at the reported time in the past as if he ascribes to \( s \) the property of being a state of Mary’s being in the room (Ogihara, 1995: 205). Note that this state \( s \) has to hold at \( n \). In (4a) and (4b), but not in (4c), there is such a state still holding, namely Sue’s being in the room. This predicts correctly that (4a) and (4b) are acceptable, in contrast to (4c).

Ogihara thus proposes that (4) is an example of de re reports about states: John makes an utterance about a state which happens to hold at the actual utterance time, without this moment (which is in the future for him) playing a role in his mind. Building on Cresswell and von Stechow’s (1982) analysis of de re reports about individuals, Ogihara then formalises such de re reports about states in terms of acquaintance relations: (1) is true iff there exists a state \( s \) at the utterance time \( n \) and a suitable acquaintance relation \( R \) such that: (i) \( s \) is the state to which John bears \( R \) in the actual world and time of his utterance; and (ii) John talks at this time as if in all belief alternatives, \( s \) has the property of Mary’s being in the room. In (4a) and (4b) there
is such a state that satisfies these requirements, namely the state of Sue’s being in the room, to which John is acquainted via the relation “the situation that I am observing”. Let us leave this theoretical implementation aside for the moment and return to the **KEY OBSERVATION** that has driven this implementation. Recall that the **KEY OBSERVATION** is as follows: as long as the cause of the belief is still present at the actual utterance time $n$, the present tense is felicitous; otherwise it isn’t. As noted in the previous section, Klecha (2015) questions this **KEY OBSERVATION** with the example in (2), repeated below:

(2) Mary puts a balloon under her shirt. John then observes her in this state, and then says to everyone: ‘Mary is pregnant!’ Later that day, Mary takes the balloon out from under her shirt and pops it. Bill, aware of everything that happened, says to Mary: ‘(Earlier today,) John told everyone that you’re pregnant.’

In this scenario, the cause of John’s belief that Mary is pregnant, i.e. the state of the balloon under her shirt, is absent by the time of Bill’s report. Nevertheless, the present tense is acceptable, suggesting that the **KEY OBSERVATION** is empirically inadequate. The noted formal implementation of this observation, however, has some wiggle room. For example, Abusch (p.c.), who uses acquaintance relations to times rather than states, suggests that the acquaintance relation in (2) could pick out the day in which the attitude time (rather than the time of the balloon being under Mary’s shirt) is included, and since this day still holds at the actual utterance time the present tense is acceptable. While this would allow us to account for (2), the question, then, is why we don’t have this flexibility for the infelicitous (4c). To make headway in answering this question, we need to have a better understanding of the factors licensing a felicitous usage of the embedded present, something that is lacking at this moment. Only then will we know what a theoretical analysis should account for, and only then can we start to discuss whether analyses in terms of acquaintance relations are on the right track.

A direct comparison of (2) and (4c) reveals a key set of factors that might play a role in the acceptability of the embedded present tense: the use of *tell* in (2) versus *say* in (4c), the duration of the state in the complement, i.e. pregnancy in (2) versus being in a room in (4c), and whether or not the audience of the reported utterance still believes the complement at the time of the report (as is the natural interpretation in (2) but not in (4c)). In the next section we present two experiments that test these three factors. We return to the theoretical discussion in section 4.

### 3. Experiments

We conducted two complementary experiments to investigate the factors licensing the use of the embedded present tense, targeting precisely those types of cases of interest to Ogihara and later Klecha, where the target sentence reports a false belief. We further zoomed in on one those cases in which the cause of the belief no longer holds at the speech time. Both experiments used

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3We find very similar insights in Abusch 1997 and Heim 1994 (a reformulation of Abusch 1994), with the difference that Abusch uses acquaintance relations to intervals rather than states, while Heim uses time concepts: the meaning of descriptions by which a speaker might represent a time to herself, technically a function from world time pairs to times.

4Note that it is less clear whether Ogihara’s acquaintance relation that picks out states could be manipulated along these lines.
a similar design, differing primarily in the behavioral response requested of the participants.

3.1. Experiment 1: rating task

**Participants** Eighty-eight native English speakers, all undergraduates at Rutgers University - New Brunswick, participated. They were granted extra credit in a Linguistics or Cognitive Science course for participating. The age range of the participants was 17 to 32 years.

**Design** The experiment followed a fully-crossed $2 \times 2 \times 2 \times 3$ design (see Table 1 for an overview). There were two between-subject factors (**TENSE OF EMBEDDED VERB** (past vs. present) and **MATRIX VERB** (say vs. tell)), and two within-subject factors (**DURATION OF THE REPORTED PROPERTY** (short term vs. long term)) and **WHO WAS AWARE** of the fact that it was a false belief at the time of the report (A: the reporter alone; B: the reporter and the reported speaker; C: the reporter, the reported speaker, and the audience)).

<table>
<thead>
<tr>
<th>Factor</th>
<th>Levels</th>
</tr>
</thead>
<tbody>
<tr>
<td>EMBEDDED TENSE</td>
<td>present, past</td>
</tr>
<tr>
<td>(between subjects, within items)</td>
<td></td>
</tr>
<tr>
<td>MATRIX VERB</td>
<td>tell, say</td>
</tr>
<tr>
<td>(between subjects, within items)</td>
<td></td>
</tr>
<tr>
<td>DURATION OF THE REPORTED PROPERTY</td>
<td>short-term, long-term</td>
</tr>
<tr>
<td>(within subjects, between items)</td>
<td></td>
</tr>
<tr>
<td>WHO IS AWARE OF THE FALSITY</td>
<td>A: reporter</td>
</tr>
<tr>
<td>(within subjects, within items)</td>
<td>B: reporter, reported speaker</td>
</tr>
<tr>
<td></td>
<td>C: reporter, reported speaker, original audience</td>
</tr>
</tbody>
</table>

Table 1: Factors manipulated in Experiment 1

**Stimuli** We constructed 12 experimental scenarios for the test items. Among these 12, six items featured a short-term property (*e.g.* being in a bar), and six featured a long-term property (*e.g.* being pregnant). Within each of these there were two items each of the ‘who was aware’ factor levels, yielding four of each. Three versions of every test item were made reflecting the levels of the ‘who was aware’ factor. These were then fed into a Latin Square design.

Scenarios were structured in the following way: Each scenario began with the introduction of two key individuals (‘Ind-1’ and ‘Ind-2’) and some friends, the ‘Audience’. There were ultimately four individuals plus the audience in the scenario, whose designated roles were linked to the target sentence uttered at the end of the trial (Ind-1: Reporter; Ind-2: Reported Speaker;
A scenario was setup as follows. Ind-2 remarks aloud to Ind-1 that an ‘Ind-3’ has a long or short term property \( P \). This utterance is in fact false. Ind-1 knows this but the exclamation is acknowledged as true by the Audience at this point. The scenario then diverges based on who becomes aware of this falsity in three conditions, all three of which were seen by a single participant, across different scenarios:

(A) Ind-1 remarks to Ind-2 out of earshot that the claim is false. Ind-2 holds fast to the original claim, and departs from the situation, leaving only the Reporter (Ind-1) to be aware of the falsity.

(B) Ind-1 remarks to Ind-2 out of earshot that the claim is false. Ind-2 then realizes the falsity of the original claim, mentioning this to Ind-1, leaving both the Reporter (Ind-1) and the Reported Speaker (Ind-2) aware of the falsity.

(C) Ind-1 remarks to Ind-2 in front of the Audience that the claim is false. Ind-2 then realizes the falsity of the original claim, mentioning this to Ind-1 in front of the Audience, leaving the Reporter (Ind-1), the Reported Speaker (Ind-2), and the Audience aware of the falsity.

Then in all experimental items, the state that was the cause of the false belief ceases to hold, but only those individuals who recognized the falsity of the belief above witness this change (Ind-1 in (A), Ind-1+2 in (B), and Ind-1+2 and Audience in (C)).

All scenarios were resolved in the same way: another individual (Ind-4, the Friend, not part of the original Audience) arrives a few minutes later. Ind-1 reports Ind-2’s original claim to Ind-4 (hence, the role of Reporter and Reporter Speaker), saying, “Ind-2 [said/told us] that [Ind-3 VP].” Participants were asked to respond to this target sentence, given the scenario they had just read.

Examples of two experimental items (one with a short-term property and one with a long-term property) are provided in (5) and (6), with the target sentence in bold face.

(5) **Short-term property**
Alex, Bill, and some other friends are hanging out. Alex and Bill both look into a room. Cindy is in the room. But Alex is near-sighted and can’t see that well. He turns to Bill, in earshot of the others, and says, “Look! Dana is in the room.” Everyone but Bill nods in agreement.

(A) Bill pulls Alex off to the side, away from the others and replies, “What are you talking about? That’s Cindy, not Dana!” Alex says, “No, I’m sure that’s Dana.” Alex walks away. Bill remains standing there, apart from the others. Bill watches as Cindy leaves the room. No one else sees this.
(B) Bill turns to Alex in front of the others in the room and replies, “What are you talking about? That’s Cindy, not Dana.” Alex says, “Oh yeah, you’re right! That’s Cindy.” Alex and Bill remain standing there, apart from the others. Alex and Bill watch as Cindy leaves the room. The others in the room don’t see this.

(C) Bill turns to Alex in front of the others in the room and replies, “What are you talking about? That’s Cindy, not Dana.” Alex says, “Oh yeah, you’re right! That’s Cindy.” Alex, Bill, and all their friends have a good laugh about this. Everyone watches as Cindy leaves the room.

A few minutes later, Bill’s friend Edward arrives. Bill says to Edward, “You won’t believe this. Alex [said/told us] that Dana [is/was] in the room.”

(6) **Long-term property**

Marsha, Nadia, and some other girls are waiting for their gymnastics practice to start. They’ve been told that there’s a new girl on their gymnastics team named Olivia. Marsha spots her across the gym, by the uneven bars, but since Olivia is so far away, Marsha can’t see that that she is standing on a stool. Marsha says in front of the other girls, "Wow, Olivia is really tall!” All the other girls, except Nadia, have a look and nod in agreement.

(A) Nadia brings Marsha over to stretch with her away from the others and says, “What are you talking about? Olivia is not tall! She’s standing on something.” Marsha says, “No way, I can see her from here, and Olivia’s really tall.” Marsha goes off to get her ankles and wrists wrapped before practice. Marsha stays there stretching on her own. Nadia watches as Olivia gets off the stool, and is the same height as the other girls around her. No one else sees this.

(B) Nadia brings Marsha over to stretch with her away from the others and says, “What are you talking about? Olivia is not tall! She’s standing on something.” Marsha moves to get a better angle, and says, “Oh my gosh, you’re right! She is standing on something! She’s not really tall!” Marsha and Nadia remain stretching, and wait to re-join the others. Marsha and Nadia watch as Olivia gets off the stool, and is the same height as the other girls around her. No one else sees this.

(C) Nadia turns to Marsha in front of the others and says, “What are you talking about? Olivia is not tall! She’s standing on something.” Marsha moves to get a better angle, and says, “Oh my gosh, you’re right! She is standing on something! She’s not really tall!” All of the girls giggle about Marsha’s mistake. All the girls watch as Olivia gets off the stool, and is the same height as the other girls around her.

A few minutes later, Nadia’s friend Patricia arrives at gymnastics practice. Nadia says to Patricia, “You won’t believe this. Marsha [said/told us] that Olivia [is/was] really tall.”

The test items were pseudorandomized along with six control items, which shared a similar structure. The control items (three long-term and three short-term properties) had the cause of the belief present.

In addition, three practice scenarios were constructed and eight filler items were included that followed a similar make up as the experimental scenarios but contained other types of target
sentences (adverbial and embedded clauses), including clear unacceptable ones.

Materials were divided over 12 stimuli lists, following a Latin square design.

Procedure Participants were tested in a laboratory at individual stations. The entire experimental session lasted approximately 25-30 minutes. The experiment began with a brief 3-item training session to acclimate participants to the task.

Stimuli were presented on an iMac using Superlab 4.5 software, in randomized order. Each subsequent aspect of the scenario (introduction of the scenario, exchange between the individuals, etc.) was presented sequentially on the screen, with participants pressing buttons to advance through the scenario at their own pace.

After the target sentence was shown on screen, participants were asked to rate the acceptability of the target sentence on a 5-point scale, ranging from 1 to 5 with: 1: not acceptable at all, 2: hardly acceptable, 3: moderately acceptable, 4: acceptable, 5: definitely acceptable. ‘Acceptability’ was defined as whether or not a native speaker of English would express the sentence in the way presented. Participants were told that, “A native speaker of English is someone who has known English since childhood. This person may not actually have been born in this country. This person’s parents may not speak English. However, this person is considered to be a fluent speaker of English, and could provide judgments about English sentences as a fluent speaker if asked to do so.” Participants were also explicitly told that the person who delivered the target statement was always speaking truthfully, and so this sentence is always true, but the participants were asked to focus on whether or not it was ok for the speaker to say it in this way and rate acceptability.

Results Acceptability ratings were converted to z-scores to control for variability in scale use. The resulting scores were analyzed with generalized linear mixed models using the lmerTest package in R (Kuznetsova et al., 2015). Models were fitted the maximal random effects structure justified by the data. Factors were entered into the model using sum coding. Due to the complexity of the design and small numbers of items per condition, we only report effects of individual factors and their interaction with the factor TENSE OF EMBEDDED VERB.

EMBEDDED TENSE: Figure 1 shows the overall scores for target sentences in the present tense \((M = .13, SD = .82)\) and in the past \((M = .21, SD = .79)\). A model with EMBEDDED TENSE as a fixed factor and a random intercept for PARTICIPANT and a random intercept with random slope for ITEM revealed no significant difference. Note that, when looking at the raw scores, both types of sentences seem to be rated as acceptable (PRS: \(M = 3.82, SD = 1.43\); PST: \(M = 4.02, SD = 1.34\)).

MATRIX VERB: The results for MATRIX VERB are shown in Figure 2. A model with the interaction between MATRIX VERB and EMBEDDED TENSE as fixed factors and a random intercept for PARTICIPANT and a random intercept with random slopes for the two fixed factors for ITEM
DURATION OF THE REPORTED PROPERTY: The results for this factor are shown in Figure 3. The findings suggest that the effect of this factor is different in target sentences with present tense compared to those with past tense. A model with the interaction between DURATION OF THE REPORTED PROPERTY and EMBEDDED TENSE as fixed factors and random intercept and random slope of DURATION for PARTICIPANT and a random intercept with a random slope of EMBEDDED TENSE for ITEM revealed a significant interaction ($\beta = .115$, $SE = .04$, $t = 2.93$, $p = .009$). A follow-up analysis of simple effects revealed a significant effect of EMBEDDED TENSE on the rating of short-term properties. Short-term properties were rated significantly lower in sentences with embedded present tense ($M = .01$, $SD = .84$) than in those with past tense ($M = .33$, $SD = .75$; $\beta = -.156$, $SE = .05$, $t = -3.47$, $p = .004$).
**Figure 3:** Mean z-scores of acceptability ratings from Experiment 1 for **Duration of Reported Property**, error bars show 95% CI.

**Who is Aware of the Falsity:** Figure 4 shows the scores for **Who is Aware of the Falsity**. The judgments show a lot of variation. The maximally converging model with the interaction between **Who is Aware of the Falsity** and **Embedded Tense** as fixed factors and random intercept and random slope of **Who is Aware of the Falsity** for **Participant** and a random intercept with a random slope of **Who is Aware of the Falsity** and **Embedded Tense** for **Item** revealed a significant interaction effect ($\beta = .087, SE = .04, t = 2.24, p = .028$). A follow up analysis of simple effects revealed a significant effect of **Embedded Tense** on the rating of sentences in which the reporter, the reported speaker and audience are all aware of the falsity (level C) in a model with the maximal random structure. These sentences were rated significantly lower with embedded present tense ($M = .004, SD = .87$) than with past tense ($M = .31, SD = .76; \beta = -.137, SE = .006, t = -2.27, p = .04$).

**Figure 4:** Mean z-scores of acceptability ratings from Experiment 1 for **Who is Aware of the Falsity** (A: the reporter alone; B: the reporter and the reported speaker; C: the reporter, the reported speaker, and the audience), error bars show 95% CI.
CONTROL: Finally, we compared the overall scores on the test items with control items in which the cause of the false belief remained present. Figure 5 shows a numeric trend towards a higher acceptability of control items in the present tense, but this was not substantiated by the statistical analysis in which ITEM TYPE (test, control) was included. A model with ITEM TYPE as a fixed factor and a random intercept and random slope of ITEM TYPE for PARTICIPANT and a random intercept for ITEM revealed no significant effect.

![Figure 5: Mean z-scores of acceptability ratings from Experiment 1 for control items vs. test items, error bars show 95% CI.](image)

The acceptability ratings from Experiment 1 were revealing of the acceptability of the present tense in the embedded clause. However, one might wonder if participants were inclined to inflate the acceptability of the present tense because they did not know the past tense was an explicit option within the same session. We wondered if participants would allow the present tense even when they were made aware that the past tense was available. We therefore conducted Experiment 2, using highly similar stimuli, but with a forced-choice behavioral measure, in which participants were asked to choose between present and past tense for the embedded clause. We reasoned that if participants chose the present tense even in such a task, when the past tense was a viable option, then this would be empirical evidence that the present tense was licensed. Moreover, if the preference was correlated with the manipulation of the target factors (duration of the property and who is aware of the false belief), then this would be evidence that such factors influence the felicity of present tense in the embedded clause.

3.2. Experiment 2: forced choice task

Participants 41 English speakers, all undergraduates at Rutgers University - New Brunswick, participated. As in Experiment 1, they were granted extra credit in a Linguistics or Cognitive Science course for participating. The age range of the participants was also 17 to 32 years.
Stimuli  The stimuli had the same structure as in Experiment 1. However, there were two minimal changes. First, since the matrix verb did not produce a significant main effect in Experiment 1, the matrix verb was always tell. Second, participants were asked to choose between one of two target sentences at the end of the scenario: one with embedded present and the other with embedded past tense. Thus, the experiment had two within-subject factors (DURATION OF THE REPORTED PROPERTY (short-term vs. long-term)) and WHO WAS AWARE OF THE FALSITY (A: the reporter alone; B: the reporter and the reported speaker; C: the reporter, the reported speaker, and the audience)).

Procedure  As before, the experiment began with a brief training session of three items to acclimate participants to the task. This time, data were presented on the Qualtrics platform online. Each subsequent aspect of the scenario was presented sequentially on the screen (see (5), yielding five windows of presentation). Participants pressed a ‘next’ button to advance through the scenario at their own pace. When presented with the target sentence, participants were asked to select the form of the embedded verb by choosing between a present and past tense form. The experimental session lasted approximately 25 minutes.

Results  The binary data were analyzed using binomial generalized mixed effect models using the lmerTest package in R (Kuznetsova et al., 2015). Models were fitted with the maximal random effects structure justified by the data. Factors were entered into the model using sum coding. Figures show mean percentages of choice for the present tense. As for experiment 1, we only report effects of individual factors, due to the complexity of the design and small numbers of items per condition.

DURATION OF THE REPORTED PROPERTY: This factor also turned out to have an effect on the choice for present tense in Experiment 2. Figure 6 shows a higher percentage of present tense for long-term properties (M = 62%) in comparison for short-term properties (M =22%). This effect was significant in a model with DURATION as a fixed factor and random intercept and slopes for both PARTICIPANTS and ITEMS (β = 1.10, SE = .18, Z = 6.2 , p < .001).

WHO IS AWARE OF THE FALSITY: Figure 7 shows the results for this factor. There seems to be a numeric trend for a preference of present tense when only the reporter is aware of the falsity of the belief (Condition A). A statistical model with WHO IS AWARE OF THE FALSITY as a fixed effect and as a random slope for PARTICIPANT and ITEM only showed a trend towards significance (p = .09). The same was obtained in a model using treatment coding. Even though condition C was significantly different from condition A (p = .041) within the model, model comparison showed that the addition of the factor to a baseline model was only marginally so (p = .07). This may reflect a power issue.

CONTROL: Finally, we compared the choice for present tense on the test items with that on control items in which the cause of the false belief remained present. Figure 8 shows no difference between the items and this was confirmed by the statistical analysis in which ITEM TYPE (test, control) was included. A model with ITEM TYPE as a fixed factor and a random intercept
Figure 6: Mean percentage of choice for present tense in Experiment 2 for DURATION OF REPORTED PROPERTY, error bars show 95% CI.

Figure 7: Mean percentage of choice for present tense in Experiment 2 for WHO IS AWARE OF THE FALSITY (A: the reporter alone; B: the reporter and the reported speaker; C: the reporter, the reported speaker, and the audience), error bars show 95% CI.
and random slope of ITEM TYPE for PARTICIPANT and a random intercept for ITEM revealed no significant effect.

Figure 8: Mean percentage of choice for present tense in Experiment 2 for control items vs. test items, error bars show 95% CI.

4. Discussion

In the two experiments we have seen that when the cause of belief no longer holds, as in the Klecha-type example: (i) short term properties disfavor present tense and (ii) belief state of others seem to effect present tense use: present tense is better when people still entertain a false belief. (ii) is particularly interesting since it means that tracking other people’s beliefs affects our choice of grammatical morphemes, even in the case of people who are not participating in the actual conversation. More research is needed to corroborate the effects of this factor.

Surprisingly, whether the cause of the false belief still holds—the key factor according to Ogihara—did not make a difference.

Why should this be? And how can we generalize over the various factors? For Costa (1972) and McGilvray (1974), the answer has to do with current relevance, an appealing notion since, after all, we are interested in the meaning of the present tense.

It seems possible to rephrase our findings as having to do with current relevance. The cause of the belief still holding at the actual utterance time (Ogihara’s KEY OBSERVATION) is then just one of the ways in which the proposition expressed by the complement can still be relevant to the conversation the reporter is engaged in. Another way in which this proposition can be relevant at the time of the report is if the original audience still (falsely) believes it (factor (ii)). Yet another way could be cases where we do not expect changes to happen in the truth value of the proposition expressed by the complement between the reported time and the time of the report (i.e. the actual utterance time, n) (in line with in the category of eternal statements, a category mentioned in many textbooks of English, see Eckhardt 2001: p. 44 for an overview). This corresponds to factor (i), the duration of the reported property: for long-term properties (in
our items usually individual-level properties) such a change is implausible: had the complement been true at the reported time it would still be true at the actual utterance time.

The challenge for *de re* analyses of tense noted in section 2 is to show how the determination of particular acquaintance relations— which concerns how an attitude holder became acquainted with a time/state—is sensitive to these factors. This is a challenge because it’s unclear how the latter two factors above would matter for acquaintance: the second factor involves an audience whose beliefs may be independent of the attitude holder’s beliefs, while the third factor involves counterfactual reasoning. While it is not out of the question that a richer, pragmatic theory of acquaintance relations could derive the factors above, it is not clear to us what such a theory would be like.

Another possibility is to provide an analysis of the embedded present tense that does not depend on acquaintance relations. While this would be a move away from the orthodoxy, we note that Klecha (in this volume) provides a glimpse of what such a move may be like. He proposes that semantically speaking, the use of the embedded present tense leads to ill-formedness when it is embedded under past, requiring pragmatic intervention to be rescued. According to Klecha, a double access interpretation is *non-literal*, a special kind of loose talk. While presenting the details of this analysis would take us too far a field, several comments are in order. Klecha’s key idea is that present-under-past sentences can be felicitously used when “the temporal resolution in the discourse is sufficiently coarse so as to conflate the event time of the attitude verb with speech time; in other words, in discourses where the interlocutors don’t care to make the distinction between event and speech time for the purposes of discussing what they’re discussing.” When the discourse is not sufficiently coarse, pragmatic enrichment via conflation of the speech time and the event time will not be triggered and infelicity will arise due to the Upper Limit Constraint (Abusch 1997).

This conflation between the event and the speech time could be an intriguing way to make sense of our factor (i) and perhaps even of the idea of current relevance in general. While more work is required to make sense of how exactly Klecha’s proposed pragmatic enrichment is sensitive to the factors noted above, this task seems, on the face of it, promising. We leave this task open for further research. Our contribution here is a demonstration of how the applications of experimental methods may lead to important contributions to a theory of embedded tense, which must involve a sufficient pragmatic theory that complements the semantics.6

References


5Though in line with Hawthorne and Manley 2012, who argue that semantic theorizing should not involve acquaintance relations. See also Altshuler and Schwarzschild 2013; Bary and Altshuler 2014; Altshuler 2016, where an analysis of embedded tense is proposed without invoking *de re* mechanisms, though the analysis does invoke time concepts, viz. Heim 1994.

6See also Altshuler et al. 2015 for a corpus study that reaches the same conclusion by independent means.
Equational-intensional relative clauses with syntactic reconstruction
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Abstract. Analyses of scope reconstruction typically fall into two competing approaches: ‘semantic reconstruction’, which derives non-surface scope using semantic mechanisms, and ‘syntactic reconstruction’, which derives it by positing additional syntactic representations at the level of Logical Form. Grosu and Krifka (2007) proposed a semantic-reconstruction analysis for relative clauses like the gifted mathematician that Dan claims he is, in which the relative head NP can be interpreted in the scope of a lower intensional quantifier. Their analysis relies on type-shifting the relative head into a predicate of functions. We develop an alternative analysis for such relative clauses that replaces type-shifting with syntactic reconstruction. The competing analyses diverge in their predictions regarding scope possibilities in head-external relative clauses. We use Hebrew resumptive pronouns, which disambiguate a relative clause in favor of the head-external structure, to show that the prediction of syntactic reconstruction is correct. This result suggests that certain type-shifting operations are not made available by Universal Grammar.

Keywords: relative clauses, scope, reconstruction, type-shifting, de dicto, intensional quantifiers, binding, resumptive pronouns.

1. Introduction

Our focus in this paper is on one kind of relative clauses (RCs) with an embedded intensional quantifier and a copular clause, analyzed in Grosu and Krifka (2007) and illustrated in (1). Following Grosu and Krifka (2007), we refer to such RCs as ‘equational-intensional RCs’.

(1) The gifted mathematician that Dan claims he is should be able to solve this problem

The sentence in (1) has two readings which we will refer to as de dicto and de re. According to the de dicto reading, given Dan’s claim that he is mathematically gifted, he should be able to solve this problem. On the less salient de re reading, there is a certain gifted mathematician, say Hilbert, who should be able to solve this problem; Dan claims that he is Hilbert.

The de dicto reading presents an apparent mismatch between the syntax and the semantics of (1). On the semantic side, the de dicto reading does not imply the existence of a gifted mathematician, but rather only that Dan claims to be one. This suggests that the world variable of the relative head gifted mathematician should be bound by the intensional quantifier claim in the logical representation of the de dicto reading of (1), as schematized in (2). On the syntactic side, on the other hand, the relative head gifted mathematician is not c-commanded by the intensional quantifier claim in the surface structure of (1). The challenge, then, is that

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the relative head *gifted mathematician* seems to be interpreted in a pre-movement position—a scope-reconstruction effect.

\[ \forall w \in \text{CLAIM}_{Dan, @} \left[ \ldots \text{gifted-math}'(w) \ldots \right] \]

where \( \text{CLAIM}_{Dan, @} \) stands for the set of worlds compatible with Dan’s claims in the utterance world.

The literature offers two main approaches to scope reconstruction. The first approach places the burden of explanation on the syntax by interpreting the higher NP in a low (‘reconstructed’) position at the level of ‘Logical Form’ (LF) (Chomsky 1993; Romero 1998, 2004; Fox 1999; Heim 2012, among others). We label this approach \( \text{SYN}_R \) (for syntactic reconstruction). The second approach accounts for the mismatch by complicating the semantics using semantic operations such as type-shifting, which often take the surface syntactic structure as their input (Jacobson 1994; Cresti 1995; Rullmann 1995; Lechner 1998; Sharvit 1999; Ruys 2011, among others). We label this second approach \( \text{SEM}_R \) (for semantic reconstruction).

The present paper compares the two main approaches to scope reconstruction—\( \text{SYN}_R \) and \( \text{SEM}_R \)—with respect to equational-intensional RCs like (1).

An analysis of the *de dicto* reading of equational-intensional RCs within \( \text{SEM}_R \) was developed by Grosu and Krifka (2007) (henceforth G&K). Here is a sketch of their analysis. G&K take the matrix subject to denote an individual concept, a function from worlds to individuals. In particular, the subject denotes the function that maps each world compatible with Dan’s claims to Dan, who is a gifted mathematician in that world (3).

\[ \text{Individual-concept denotation of the subject} \]

\[ [[\text{the gifted mathematician Dan claims he is}]] = \lambda f_{(s,e)} \left[ \text{dom}(f) = \text{CLAIM}_{Dan, @} \land \forall w \in \text{CLAIM}_{Dan, @} [\text{DAN}(w) = f(w) \land \text{gifted-math}'(w)(f(w))] \right] \]

The main ingredient of G&K’s compositional derivation of (3) is a semantic mechanism that has two functions: it type-lifts the relative head *gifted mathematician* from a predicate of individuals to a predicate of individual concepts, and it binds the world of evaluation of the relative head. The basic meaning of the relative head on this analysis is given in (4) and the type-shifted meaning is given in (5). The RC that *Dan claims he is* is assumed to involve abstraction over an individual-concept variable and has the denotation in (6).

\[ [[\text{gifted-mathematician}]] = \lambda x. x \text{ is a gifted-math’ in @} \]

\[ \text{TS}([[\text{gifted-mathematician}]] = \lambda f_{(s,e)} \left[ \forall w \in \text{dom}(f) [[\text{gifted-mathematician}](f(w))] \right] \]

\[ [[\text{that Dan claims he is}]] = \lambda f_{(s,e)} \left[ \forall w \in \text{CLAIM}_{Dan, @} [\text{DAN} = f(w)] \right] \]

The RC and the type-shifted head are of the same type and can combine intersectively (7a) to derive the meaning in (7b).
(7)  a. TS[gifted-mathematician][that Dan claims he is]
    type <s,t>
    type <s,t>
    b. \( \lambda f_{(s,e)} . \forall w \in \text{CLAIM}_\text{Dan}@ \left[ \text{DAN} = f(w) \right] \land \\
       \forall w \in \text{dom}(f) \left[ \left[ \text{gifted-mathematician} \right]^w(f(w)) \right] \)

In (7b), the world parameter of gifted mathematician is bound by \( \forall w \in \text{dom}(f) \). On the assumption that the can pick up the smallest function in (7b) (for details see G\&K as well as the appendix), we get the meaning of the entire subject in (3), in which the domain of the function \( f \) is \( \text{CLAIM}_{\text{Dan}@} \). The result is that the world parameter of gifted mathematician ends up being bound by claim without interpreting the relative head NP (or any other constituent) in a non-surface position.\(^3\)

An alternative theory of the de dicto reading of (1) within SYN R will be developed in detail in section 2. The main ingredient of the proposed theory, assuming the Copy Theory of Movement (Chomsky 1993), is a syntactic representation where only the low (unpronounced) copy of the relative head is semantically interpreted, as schematized in (8). As for the semantics, the theory draws on the semantics of syntactic reconstruction in Heim (2012).

(8) LF: The gifted-mathematician that ... claim ... gifted-mathematician

As mentioned above, our goal is to compare the two competing approaches to scope reconstruction—SEMR and SYN R—with respect to equational-intensional RCs like (1). We do so in three steps. First, we develop the theory of the de dicto reading in equational-intensional RCs within SYN R (section 2). After developing the theory in section 2, we discuss a point of divergence in predictions between SEM R and SYN R with respect to equational-intensional RCs (section 3). The divergence concerns the availability of de dicto readings in head-external RCs. As we show in section 3, SEM R generates de dicto readings in head-external RCs, but SYN R without type-shifting does not. Finally, in section 4 we use Hebrew resumptive pronouns as a case study to test the divergent prediction presented in section 3. Hebrew resumptive pronouns are suitable for this task since they can disambiguate an RC in favor of the head-external structure, where the two approaches diverge. Extending an observation by Doron (1982), we show that de dicto readings are absent in the presence of resumptive pronouns. The absence of de dicto readings with resumptive pronouns is exactly what SYN R predicts, but it is surprising if type-shifting operations like (5) are made available by Universal Grammar.

\(^3\)G\&K’s analysis is related to SEMR accounts of functional readings in questions and RCs, illustrated in (i), where a variable of type \((e)\) (underlined) appears to be bound by a non-c-commanding quantifier (in bold).

(i) a. Which [picture of herself] did every girl, submit?  (Engdahl 1986)
    b. The [relative of his] that every man, likes best is his, mother (Geach 1964; Jacobson 1994, 2002)

Engdahl (1986) (for questions) and Sharvit (1999) and Jacobson (2002) (for RCs) posit a type-shifting operation along the lines of G\&K’s (5) that binds individual variables (rather than world variables) and shifts an NP into a predicate of functions of type \((e,e)\) (rather than type-\((s,e)\) functions). See Heim (2012) for an analysis of functional readings that uses syntactic reconstruction and forgoes type-shifting.
2. Syntactic Reconstruction

2.1. Preliminaries

In this section we develop the SYN R theory of the de dicto reading of (1), repeated in (9), focusing on the denotation of the matrix subject.

(9) [The gifted mathematician that Dan claims he is] should be able to solve this problem.

Here are some of the differences between the SYN R theory we propose in this paper and G&K’s SEMR theory. The first difference, which is not our focus in this paper, is the following. While SEMR is committed to an individual-concept denotation for the subject as in (3), SYN R can generate the de dicto reading both with an individual-concept denotation for the subject as in (3) and with the individual denotation in (10).

(10) Individual denotation of the subject

\[ \varepsilon x [\forall w \in \text{CLAIM}_{Dan, \Theta} [x \text{ is a gifted-math'} \text{ in } w \land x = Dan]] = \text{Dan, who is a gifted math'} \text{ in all worlds compatible with his claims} \]

We bring up the compatibility of SYN R with (10) to simplify the presentation of the approach. It turns out that the compositional details of the individual denotation in (10) are simpler than those of the individual-concept denotation in (3), so we will present SYN R using (10) in what follows. For completeness, we provide the derivation of the individual-concept denotation in (3) under SYN R in the appendix, and we will show that the main prediction of SYN R we discuss in this paper is made with both denotations.

Our focus in this paper is on the differences between SEMR and SYN R that have to do with the mechanism responsible for scope reconstruction: first, the SYN R theory we propose assumes that the moved NP gifted mathematician is interpreted in a low (reconstructed) position at LF, as schematized above in (8); second, the proposed theory relies on the unavailability of the type-shifting operation posited by G&K. We stipulate that G&K’s type-shifter in (5), repeated in (11) in its general form, is not made available by Universal Grammar. In the present paper, we assume the stipulation in (11) without discussion and do not try to derive the absence of the type-shifter from deeper principles.

The uniqueness requirement of the iota operator in (10) is met assuming that individuals are the same across worlds (Kripke 1980). Note that (10) is an oversimplified representation which ignores issues such as binding of individual variables into intensional contexts (Quine, 1956). We will stick to this oversimplified representation since, as far as we can tell, those issues can be resolved in ways that do not bear on the mechanism responsible for scope reconstruction (see, e.g., Percus and Sauerland 2003).

G&K’s SEMR analysis derives the de dicto reading through a combination of abstraction over individual-concept variables and type-shifting. Since both ingredients can be dispensed with under SYN R, excluding the SEMR derivation of the de dicto reading could also be achieved by banning abstraction over individual-concept variables (as an alternative to banning type-shifting). Defending that alternative seems to us like a non-trivial challenge given that traces can be arguments of predicates that arguably take individual-concept arguments (like rise), as in the number of residents in this city is 250,000, a number that rose significantly in the past decade, so we do not pursue that alternative here (see Montague, 1973 and later literature for discussion of predicates of individual concepts). In addition, to our knowledge G&K’s type-shifter has not been used elsewhere in the literature.
Universal Grammar does not make available the following type-shifter:

\[ \text{TS}(P_{(s,e)}) = \lambda f_{(s,e)} : \forall w \in \text{dom}(f) \left[ P(w)(f(w)) \right] \]

Assuming (11), we proceed to develop the theory behind (10) under SYN R by first presenting our assumptions about the syntax in 2.2. Then, in 2.3, we present the semantic composition of the subject, followed by the combination of the subject with the rest of the sentence in 2.4.

2.2. Syntax

Our proposal for the LF of the subject is given in (12). We assume a ‘head-raising’ derivation of the RC, where the relative head NP is generated inside the RC and undergoes movement to its surface position (Schachter 1973; Vergnaud 1974; Bhatt 2002, among others). The high (pronounced) copy of the head NP is deleted and its low copy is converted into a definite description using the mechanism of Trace Conversion (Fox 2002, Sauerland 2004, Heim 2012).

(12) The \( \text{GM} \lambda x_e \text{ Dan claims} \underbrace{\lambda w \left[ \text{he is} \ \text{THE} \ [\text{GM}_w \ [\text{IDENT} \ x_e]] \right]}_{\text{Converted trace}} \)

The syntactic derivation of (12) proceeds as in (13). First, the RC \textit{Dan claims that he is a gifted mathematician} is constructed by repeated application of external merge. Then, the NP \textit{gifted mathematician} is copied through internal merge, which we take to insert a binder below the copied NP (Heim and Kratzer 1998). Next, the definite article is externally merged. Trace Conversion converts the lower copy into a definite description and the lower determiner is deleted (cf. Heim 2012). Then, the higher NP is deleted. Finally, two world variables, which we assume to be represented in the syntax (see, e.g., Cresswell 1990), are inserted and saturate the world argument of the predicates \textit{claims} and \textit{gifted mathematician}.

(13) LF derivation (cf. Heim 2012):

\begin{align*}
\text{Construct TP:} & \quad \text{Dan claims} \underbrace{\lambda w \left[ \text{he is} \ \text{GM} \right]}_{\text{he is a GM}} \\
\text{Internal-merge NP:} & \quad \text{GM} \underbrace{\lambda x_e \text{ Dan claims} \lambda w \left[ \text{he is} \ \text{GM} \right]}_{\text{he is a GM}} \\
\text{External-merge the:} & \quad \text{the} \ \underbrace{\text{GM} \lambda x_e \text{ Dan claims} \lambda w \left[ \text{he is} \ \text{GM} \right]}_{\text{he is a GM}} \\
\text{Trace conversion + Det:} & \quad \text{the GM} \lambda x_e \text{ Dan claims} \lambda w \left[ \text{he is a} \ \text{THE} \ [\text{GM} \text{IDENT} \ x_e] \right] \\
\text{Delete higher NP:} & \quad \text{the GM} \lambda x_e \text{ Dan claims} \lambda w \left[ \text{he is} \ \text{THE} \ [\text{GM} \text{IDENT} \ x_e] \right] \\
\text{Insert world pronouns:} & \quad \lambda x_e \text{ Dan claims} \underbrace{\lambda w \left[ \text{he is} \ \text{THE} \ [\text{GM}_w \ \text{IDENT} \ x_e] \right]}_{\text{he is a GM}}
\end{align*}

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6Our choice of the indefinite article as the lower determiner is arbitrary. Since that determiner eventually gets deleted, other choices would not have made a difference.
2.3. Semantics

We now show that the LF in (12) results in the desired individual denotation of the subject in (10), repeated here:

\[ \forall w \in \text{CLAIM}_{Dan, @} [x \text{ is a gifted-math' in } w \land x = Dan] \]

= Dan, who is a gifted math' in all worlds compatible with his claims

The interpretation procedure makes important use of the mechanism of presupposition projection, following Heim (2012). We present the central steps of the interpretation of the LF in (15) going bottom-up.

(15) The \( \lambda x \) Dan claims \( \lambda w [he_2 \text{ is THE [GM}_w \ \text{IDENT } x_2)] \]

For the first step, THE and IDENT are defined as in (16) and (17). The converted trace has the interpretation in (18).

(16) \( \llbracket \text{THE} \rrbracket = \lambda P(x,t) : \exists !x[P(x)]. \llbracket P(x) \rrbracket \)

(17) \( \llbracket \text{IDENT} \rrbracket = \lambda x. \lambda y. x = y \)

(18) \( \llbracket \text{THE [GM}_w \ \text{IDENT } x] \rrbracket^g \) is defined only if \( g(x) \) is a gifted-math' in \( g(w) \);
where defined, \( \llbracket \text{THE [GM}_w \ \text{IDENT } x] \rrbracket = g(x) \)

Our entries for the copula and claim are given in (19) and (20). claim projects the presuppositions of its complement universally, as indicated by the statement that immediately follows the colon in (20). Thus, the presupposition introduced in (18) projects universally as in (21).

(19) \( \llbracket \text{be} \rrbracket = \llbracket \text{IDENT} \rrbracket = \lambda x. \lambda y. x = y \)

(20) \( \llbracket \text{claim} \rrbracket = \lambda w. \lambda p(x,t). \lambda x : \forall w' \in \text{CLAIM}_{x,w} [w' \in \text{dom}(p)]. \forall w' \in \text{CLAIM}_{x,w} [p(w') = 1] \)
where \( \text{CLAIM}_{x,w} \) is the set of worlds compatible with \( x \)’s claims in \( w \)

(21) \( \llbracket \text{Dan claims}_2 \lambda w [he_2 \text{ is THE [GM}_w \ \text{IDENT } x]] \rrbracket^g \) is defined only if \( \forall w \in \text{CLAIM}_{Dan, @} [g(x) \text{ is a gifted-math' in } w] \);
where defined, it equals 1 iff \( \forall w \in \text{CLAIM}_{Dan, @} [Dan = g(x)] \)

The next step, in (22), is abstraction over the variable \( x \). For this step, notice that we can simplify the assertive component of (21) and replace \( \forall w \in \text{CLAIM}_{Dan, @} [Dan = g(x)] \) with the equivalent statement \( [Dan = g(x)] \) (assuming that \( \text{CLAIM}_{Dan, @} \) is not empty). The presupposition in (21) continues to project, this time by making the result of the abstraction a partial function defined only for individuals that satisfy the presupposition. (22) denotes the characteristic function of the singleton containing Dan, who is (presupposed to be) a gifted mathematician in each of his CLAIM worlds.
The combination of (22) with the definite article yields the denotation of the subject in (23), as desired.

(23) \[ \{ \lambda x_e \text{Dan}_2 \text{claims}_@ \lambda w \text{he}_2 \text{is} \text{THE} \{ \text{GM}_w \text{IDENT } x_e \} \} = \\
\lambda x_e : \forall w \in \text{CLAIM}_\text{Dan}_@ [x \text{is a gifted-math’ in } w] \\
. \text{Dan} = x \]

Since \textit{gifted mathematician} is interpreted in the scope of \textit{claim}, the reconstruction effect is achieved using syntactic reconstruction and without the type-shifter in (11).

2.4. Combination of the subject with the rest of the sentence

The combination of the subject with the rest of the sentence proceeds in the usual way, as in (24). For concreteness, we assume that the subject reconstructs below \textit{should} at LF as in (24a). The structure in (24a) results in the denotation in (24b).\(^7\)

(24) \text{The gifted mathematician Dan claims he is should be able to solve this problem}

\begin{itemize}
  \item a. LF: \text{Should}_@ \lambda w [\{ \lambda x \ldots \text{GM} \ldots \} \{ \text{be-able}_w \text{to solve this problem} \}]
  \item b. \forall w' \in \text{SHOULD}_@ [\{lx [x = \text{Dan} \land \forall w \in \text{CLAIM}_{\text{Dan}_@} [x \text{is a gifted-math’ in } w] \} \\
  \text{is able to solve this problem in } w']
\end{itemize}

3. A divergent prediction

In this section, we show that \textit{SYNR} ties the availability of the \textit{de dicto} reading in equational-intensional RCs to the syntactic structure of the RC, whereas \textit{SEMR} does not. Importantly, \textit{SYNR} and \textit{SEMR} diverge in their predictions regarding the availability of the \textit{de dicto} reading with head-external derivations of the RC, where the relative head is generated outside of the RC. Such derivations include the classical derivation where a null operator undergoes \AA-movement (Chomsky, 1977), the so-called ‘matching’ derivation where an NP undergoes \AA-movement and gets deleted (Chomsky 1965; Sauerland 1998), and, as we will see later, derivations with no \AA-movement inside the RC whatsoever. In particular, as we now show, \textit{SYNR} but not \textit{SEMR} makes the prediction in (25).

(25) \textbf{Prediction of \textit{SYNR}: the \textit{de dicto} reading in an equational-intensional RC will be}
\textit{blocked when the RC is unambiguously head-external}

\(^7\)On the most salient interpretation of (24), Dan would be able to solve the problem under normal circumstances that would arise assuming that his claims are true. That is, the domain of \textit{should} seems to be restricted to a subset of the worlds compatible with Dan’s claims. See Kratzer (2012) for a theory of modality that can derive this restriction contextually by appealing to the contextually-available set \textit{CLAIM}_{\text{Dan}_@}. We leave out the details for reasons of space.
To see why SYNR does not generate the *de dicto* reading with head-external RCs, consider first the situation of an RC that denotes a predicate of individuals—in fact, an intensionalized predicate of individuals (as in our analysis in section 2). Since the relative head has not undergone movement, it must be interpreted in its surface position, above the intensional quantifier. The *de dicto* reading is not derived because the world argument of the head is not bound by the quantifier. This scenario is schematized in (26), where the world argument @ and the binder are given in bold.

\[
\begin{array}{cl}
\llbracket \text{gifted-math'} @ \rrbracket \llbracket \lambda x \text{ Dan claims } \lambda w \ldots \rrbracket & \text{(de dicto not generated)} \\
type (\langle s, et \rangle) & type (\langle s, et \rangle)
\end{array}
\]

Consider now the alternative situation of an RC that denotes a predicate of individual concepts (as in the SYNR analysis of the *de dicto* reading in the appendix). Given the assumption of SYNR in (11)—namely, given that predicates of individuals cannot be type-shifted into predicates of individual concepts, interpreting the relative head outside of the RC would result in a type-mismatch between the relative head and the RC. On this scenario, which is schematized in (27), the structure would be uninterpretable.

\[
\begin{array}{cl}
\llbracket \text{gifted-math'} @ \rrbracket \llbracket \lambda f \text{ Dan claims } \lambda w \ldots \rrbracket = ?? & \text{(type-mismatch; nothing generated)} \\
type (\langle s, et \rangle) & type (\langle se, et \rangle)
\end{array}
\]

In contrast to SYNR, SEMR does not make the prediction in (25). Whether the relative head has moved from an RC-internal position or not, it can be type-shifted into a predicate of functions and get interpreted in the scope of the embedded intensional quantifier.

Our observations regarding the predicted dependency between scope and RC structure under SYNR are not new. They have been explored in various works including Sauerland (1998), Bhatt (2002), Fox (2002), Heycock (2005), and Hulsey and Sauerland (2006). Previous research has also offered diagnostics for head-external RCs such as Condition C and extraposition that might be used to test the prediction in (25) (see especially Hulsey and Sauerland 2006). In the next section, we use resumption in Hebrew—a diagnostic for head-external RCs that allows us to test the prediction in (25) using sentences that differ only minimally from the RCs discussed by G&K, and where the judgments regarding the availability of the *de dicto* reading are clear.

**4. Case study: Hebrew resumptive pronouns**

In this section we present resumptive pronouns (RPs) in Hebrew as a diagnostic for head-external RCs, and show, using that diagnostic, that the prediction of SYNR for equational-intensional RCs in Hebrew is correct. We start, in 4.1, by providing background on the distribution and interpretation of RPs in Hebrew. Then, in 4.2, we present a theory of RPs that derives their distribution and interpretation from the assumption that RPs inhabit head-external RCs. Finally, in 4.3, we use Hebrew RPs to test the divergent prediction of SYNR and SEMR regarding equational-intensional RCs in Hebrew. (Readers who are familiar with resumption as a diagnostic for head-external structure may wish to proceed directly to 4.3.)
4.1. Background: the distribution and interpretation of Hebrew resumptive pronouns

RPs are pronouns that appear in unbounded dependency constructions such as RCs, questions, and clefts, in positions where we would otherwise expect a gap. The Hebrew RC in (28) illustrates: a pronoun optionally occurs in direct object position, where other languages, like English, must use a gap. 8 We focus here on Hebrew RPs in RCs which, in simple RCs, alternate with a gap. 9

(28)  
ze  ha-sefer  še-karati  0/oto etmol  
this the-book that-I.read 0/it yesterday  
‘This is the book that I read yesterday’

The literature on RPs has argued that RPs like the one in (28) are incompatible with movement (Chomsky 1977, McCloskey 1979, McCloskey 1990, Borer 1984, Shlonsky 1992, among others). Evidence that movement is not involved includes the insensitivity of RPs to islands, as well as environments where RPs are not interpreted like gaps, which suggests they are not merely phonological spell-outs of gaps (Doron 1982, Sichel 2014).

The examples in (29) illustrate that Hebrew RPs are obligatory in island contexts, using a complex NP island in (29a) and an adjunct island in (29b).

(29)  
Evidence for non-movement #1: insensitivity to islands

a. Direct object RP, complex NP island
ze  ha-sefer  še-ani makir et  ha-iša  še-kar’a  oto/#0 
this the-book that-I know ACC the-woman that-read it/#0  
‘This is the book that I know the woman who read it’

b. Direct object RP, adjunct island
ze  ha-sefer  še-ani sameax biglal  še-karat  oto/#0 
this the-book that-I happy because that-you-read it/#0  
‘This is the book that I’m happy because you read it’

To demonstrate that RPs are not interpreted like gaps, consider the following Hebrew idiom:

(30)  
litfor  tik  le-X  
to.sew briefcase for-X  
‘to frame X for a crime’ (lit. ‘to sew a briefcase for X’)
An RC can be formed with the noun tik ‘briefcase’ as its head. In RCs headed by ‘briefcase’, the idiomatic interpretation is unavailable precisely in the presence of an RP, as shown in (31): in (31a), where an RP is optional, a gap but not an RP is consistent with the idiomatic interpretation, as observed by Sichel (2014); in (31b), an RP is obligatory and the idiomatic interpretation is unavailable.

(31) **Evidence for non-movement #2: RPs are not interpreted like gaps**

a. **RP blocks idiomatic interpretation, non-island context** (Sichel, 2014)

\[
\text{ha-tik } \overset{\text{še-tafru}}{\text{\#oto/\emptyset } \text{la-sar } \text{haya kašur } \text{le-nadlan}} \\
\text{the-briefcase that-they.sewed } \overset{\text{\#it/\emptyset}}{\text{for-the-minister was } \text{related to-real.estate}} \\
\text{‘The crime that they framed the minister for was related to real estate.’}
\]

b. **RP blocks idiomatic interpretation, island context**

\[
\text{\# ha-tik } \overset{\text{še-ani sameax biglal}}{\text{še-tafru } \overset{\text{\#it/\emptyset}}{\text{la-sar}}} \\
\text{\# the-briefcase that-I happy because that-they.sewed } \overset{\text{\#it/\emptyset}}{\text{for-the-minister}} \\
\text{haya kašur } \overset{\text{le-nadlan}}{\text{was related to-real.estate}} \\
\text{Intended: ‘I’m happy because they framed the minister for a crime related to real estate.’}
\]

Next, we show how the distributional and interpretive properties of RPs discussed in this section follow from a theory of resumption on which RPs inhabit head-external RCs.

4.2. Theory of the distribution and interpretation of resumptive pronouns

Rasin (2017), following McCloskey (2002) and Adger and Ramchand (2005) (cf. Sichel 2014), proposed an account of the distributional and interpretive properties of Hebrew RPs according to which RPs unambiguously inhabit head-external RCs that are formed without movement.

On this account, the derivation of a non-movement head-external RC proceeds as in (32). First, a TP is constructed with an ordinary pronoun. Then, a λ-binder is externally merged from the lexicon and the pronoun is abstracted over without movement. (On this view, the existence of a λ-binder in the lexicon of Hebrew is what distinguishes Hebrew from languages like English, where similar resumed relatives are unavailable.) Finally, the relative head NP is externally merged.

(32) **Derivation of a head-external structure for [book that Miri read it]**

\[
\text{Construct TP: } [TP \overset{\text{Miri read it}}{\text{\lambda_1}}] \\
\text{External-merge } \lambda\text{-binder: } [CP \overset{\lambda_1}{\text{Miri read it}}] \\
\text{External-merge } \text{book: } [NP \overset{\text{book}}{\lambda_1} \text{Miri read it}]
\]

On Rasin’s 2017 account, head-raising and head-external (non-movement) RCs co-exist in Hebrew. Head-raising RCs are formed with movement which leaves a gap, whereas head-external
RCs, which are derived as in (32), have an ordinary pronoun. The co-existence of these two RC structures in Hebrew accounts for the distribution of RPs as follows: in non-island contexts, RPs are optional because both structures are available; in island contexts, movement (hence head-raising) is unavailable, so the RP is obligatory. The interpretive effects of RPs follow as well. Consider again the blocking of idiomatic interpretations in (31). Assume, following the literature on the syntax of idioms, that a syntactic locality restriction requires a low copy of the relative head in order to achieve the idiomatic interpretation (e.g., Marantz 1997 and references cited there). The presence of an RP indicates that movement of the relative head has not taken place. This means that there is no low copy of the relative head, and thus, on the assumption regarding syntactic locality, that the idiomatic interpretation is unavailable when an RP is present. Now that we have an independently-supported theory of RPs as a diagnostic for head-external RCs, we can proceed to test the prediction presented in section 3.

4.3. Resumptive pronouns block the *de dicto* reading

Doron (1982) discovered that Hebrew RPs block *de dicto* readings in RCs with intensional transitive verbs like *seek*. Here we show that her discovery extends to equational-intensional RCs, as predicted by SYN R but not by SEM R.

The Hebrew counterpart of G&K’s example with a gap is compatible with both the *de dicto* and the *de re* interpretations, as in English:  

(33)  
\[
\text{A gap allows the *de dicto* reading, non-island context} \\
\text{ha-matematikai ha-mexunan}_i \, \text{še-ata} \, \text{toen še-} \text{ata} \, t_i \, \text{amur lehacliax liftor} \\
\text{the-mathematician the-gifted}_i \, \text{that-you claim that-you } t_i \, \text{should be.able to.solve} \\
\text{et ha-baaya be-kalut} \\
\text{ACC the-problem in-easiness} \\
\text{‘The gifted math’ that you claim you are should be able to solve the problem easily’} \\
\text{(de re, de dicto)}
\]

An RP is optional in the position of the gap. Crucially, when it is present, the *de dicto* reading is blocked (34).

(34)  
\[
\text{An RP blocks the *de dicto* reading, non-island context} \\
\text{ha-matematikai ha-mexunan}_i \, \text{še–ata} \, \text{toen še-} \text{ata } \text{hu}_i \, \text{amur lehacliax} \\
\text{the-mathematician the-gifted}_i \, \text{that-you claim that-you } \text{him}_i \, \text{should be.able} \\
\text{liftor et ha-baaya be-kalut} \\
\text{to.solve ACC the-problem in-easiness} \\
\text{‘The gifted math’ that you claim you are should be able to solve the problem easily’} \\
\text{(de re, *de dicto)}
\]

For our Hebrew sentences we use a second-person pronoun as the subject of the embedded copular sentence. For some reason, a proper name sounds unnatural in this construction and the third-person pronoun is degraded when followed by an RP, so we were not able to use them.
We tested (34) with two contexts, one that is compatible with the de re reading and one that is not (35). Speakers reported a contrast between the contexts: (34) sounded more natural to them in the de-re-compatible context (35a) than in the de-re-incompatible context (35b)\(^{11}\), suggesting that (34) is only true given the de-re-compatible context.\(^{12}\)

(35) Contexts for (34)

a. de-re-compatible context: Rina is a participant in a trivia game show. In each stage of the game, a person hiding behind a curtain claims to be a historically famous mathematician. Rina’s task is to guess the mathematician’s identity by presenting the person with statements to which the person responds ‘True’ or ‘False’. In one stage of the game, Leibniz is the mathematician whose identity Rina is supposed to guess. She writes on a piece of paper: ‘Problem: Prove that the real numbers are uncountable’. She knows that only mathematicians born after 1874, the year in which the first such proof was provided, would be able to solve the problem easily. She presents the paper and says: “True or False?.” She then says (34).

b. de-re-incompatible context: Rina is a recruiter for a high-tech company which is looking for a new mathematician. She interviews Dan for the job. During the interview, Dan tells Rina that he is mathematically gifted. To test his claim, Rina presents him with a problem that only truly gifted mathematicians can solve. She then says (34).

Similarly, an RP in an island construction blocks the de dicto reading (the sentence in (36) is unacceptable in a de-re-incompatible context, a variant of (35b) where Dan claims that he is mathematically gifted prior to being invited for an interview and his claim is the reason for the invitation):

(36) An RP blocks the de dicto reading, island context

ha-matematikai ha-mexunan i še-hizmanu otx [biglal še–ata toen
the-mathematician the-gifted_i that-we.invited you [because that-you claim
še-ata hu,/#*t_i] amur lehacliax liftor et ha-baaya be-kalut
that-you him,#*t_i] should be.able to.solve ACC the-problem in-easiness

Intended de dicto: ‘We invited you because you claim that you are mathematically gifted’

\(^{11}\)We presented the sentences in (34) and (36) by reading them out loud with intonational prominence on the RP. Shifting the prominence to toen ‘claim’ improved the acceptability of (34) in the de-re-incompatible context but did not improve the acceptability of (36) in the same context. At present, we are not sure how to make sense of the effect of prominence-shift on the judgments regarding (34). As far as we can tell, however, that effect does not undermine our argument: a contrast between de re and de dicto is still found in (34) with prominence on the RP and in (36) regardless of the intonational pattern.

\(^{12}\)The Hebrew copula is phonologically identical to a pronoun. One might wonder whether hu ‘him’ in our examples can be analyzed as a copula followed by a trace. We note that such an analysis would not account for the de re de dicto asymmetry on either theory and that it is impossible as an analysis of hu ‘him’ in (36) to begin with, since a trace is unavailable in an island construction. Furthermore, to our own judgment the de re de dicto asymmetry in (34) and (36) remains the same if we change the equational sentence to the past tense (ata hayita hu ‘(that) you used.to.be him’), where the third-person pronoun is no longer identical to the copula.
Given that the RPs above inhabit head-external relatives, and given the reasoning described in section 3, the distribution of *de dicto* readings in (33)-(36) falls out under SYN R without any special assumptions. SEM R over-generates *de dicto* readings in (34) and (36) since it is not sensitive to the structure of the RC. Minimally, SEM R would require additional constraints to block those readings. At present, we have not been able to formulate constraints (including constraints on the semantic type of pronouns) that would block the *de dicto* readings in (34) and (36) without under-generating elsewhere, though we leave a more detailed review of possible responses within SEM R to a separate occasion.

5. Conclusion

We have shown that SYN R (but not SEM R) predicts that the *de dicto* reading in equational-intensional RCs should be unavailable with unambiguously head-external RCs. We have also shown that Hebrew RPs, which disambiguate an RC in favor of the head-external structure, block the *de dicto* reading. This result is predicted by SYN R, but it is surprising under theories that allow for the type-shifter proposed by G&K.

Our result raises a few questions that we have not answered in this paper. As mentioned in section 3, other diagnostics for head-external RCs have been proposed in the literature, such as Condition C and extraposition. SYN R predicts the *de dicto* reading to disappear in those cases as well, and that prediction remains to be tested. Another question concerns intensional RCs that are not equational, such as *the dog that Mary seeks*, with the intensional operator *seek* and without an embedded copular sentence. The present paper focused on equational-intensional RCs, whose semantics—if our analysis is correct—we understand. We leave open the question of whether the proposed analysis can extend to intensional RCs that are not equational.

Our claim that SYN R but not SEM R derives the *de dicto* reading in equational-intensional RCs is consistent with hybrid approaches to scope reconstruction according to which some semantic-reconstruction mechanisms are available alongside syntactic reconstruction (Lechner 1998, Sharvit 1998, Keine and Poole 2017). The literature on SEM R has proposed various semantic mechanisms for scope reconstruction; if our claim is correct, it merely suggests that one such mechanism is unavailable: type-shifting from predicates of individuals to predicates of individual concepts. In the present paper, we made the stipulation—repeated below in (37)—that this type-shifting operation is not made available by Universal Grammar. Our result raises the question of whether this unavailability can be derived from deeper principles, a question that at present we leave open.

(37) **Stipulation regarding type-shifting**

Universal Grammar does not make available the following type-shifter:

$$\text{TS}(P_{s, et}) = \lambda f_{s, e} \cdot \forall w \in \text{dom}(f) \left[ P(w)(f(w)) \right]$$
A. Appendix: An individual-concept analysis

A.1. Analysis of the subject

In section 2 we mentioned that G&K's individual-concept denotation of the subject, repeated in (38), can be generated with syntactic reconstruction and without type-shifting. This appendix provides the relevant details.

(38) Individual-concept denotation of the subject (repeated from (3))

\[
\llbracket\text{the gifted mathematician Dan claims he is}\rrbracket = \lambda f_{(s,e)} [\text{dom}(f) = \text{CLAIM}_{Dan, @} \land \forall w \in \text{CLAIM}_{Dan, @} [\text{Dan}(w) = f(w) \land \text{gifted-math}'(w)(f(w))]]
\]

The main difference between the individual-concept version of SYNR presented here and the individual version presented in section 2 is that the semantics here involves abstraction over individual-concept variables as opposed to individual variables.

The LF we assume for the subject is given in (39). The functional variable \( f \) of type \( \langle s, e \rangle \) is abstracted over and applies to a world variable \( w \) which is itself bound by \( \lambda w \).

(39) The \( \lambda f_{(s,e)} \) Dan_2 claims_@ \( \lambda w [\text{he}_2 \text{ is THE } [\text{GM}_w \text{ IDENT } f(w)]] \)

As in section 2, we focus on the central steps of the interpretation procedure going bottom up.

The node \( \llbracket f(w) \rrbracket \) denotes the individual that \( f \) returns for \( w \), and is defined only if \( f \) is defined for \( w \) (40). The converted trace in (41) introduces the additional presupposition that \( f(w) \) is a gifted mathematician in \( w \).

(40) \( \llbracket f(w) \rrbracket^g \) is defined only if

\[
g(w) \in \text{dom}(g(f));
\]

where defined, \( \llbracket f(w) \rrbracket^g = g(f)(g(w)) \)

(41) \( \llbracket \text{THE } [\text{GM}_w \text{ IDENT } f(w)] \rrbracket^g \) is defined only if

\[
g(w) \in \text{dom}(g(f)) \text{ and } g(f)(g(w)) \text{ is a gifted mathematician in } g(w);
\]

where defined, \( \llbracket \text{THE } [\text{GM}_w \text{ IDENT } f(w)] \rrbracket^g = g(f)(g(w)) \)

The next steps of the derivation before abstracting over \( f \) proceed along the same reasoning as in section 2 and need not be repeated here. After abstraction, the denotation of the RC is as follows:

(42) \( \llbracket \lambda f_{(s,e)} \) Dan_2 claims_@ \( \lambda w [\text{he}_2 \text{ is THE } [\text{GM}_w \text{ IDENT } f(w)]] \rrbracket = \lambda f_{(s,e)} : \forall w \in \text{CLAIM}_{Dan, @} [w \in \text{dom}(f) \text{ and } f(w) \text{ is a gifted-math' in } w].
\]

\( \forall w \in \text{CLAIM}_{Dan, @} [\text{Dan} = f(w)] \)

(42) denotes the set of functions of type \( \langle s, e \rangle \) which are defined at least for all of Dan’s CLAIM worlds and which map each of Dan’s CLAIM worlds to Dan, who is (presupposed to be) a gifted
mathematician in those worlds. One function in that set is (43), the function that satisfies the condition in (42) whose domain is equal to CLAIM$^{Dan,\emptyset}$. This function is the desired denotation of the subject (38).

(43) \[ \text{if } \{ \text{dom}(f) = \text{CLAIM}^{Dan,\emptyset} \land \forall w \in \text{CLAIM}^{Dan,\emptyset} \left[ f(w) = \text{Dan} \land f(w) \text{ is a gifted-math' in } w \right] \}

In addition to (43), the set in (42) includes any other function that satisfies the condition in (42) whose domain properly contains CLAIM$^{Dan,\emptyset}$. Since the definite article requires a singleton set as its argument and (42) includes multiple functions, it cannot apply to (42). The rest of the composition follows G&K, who propose to restrict the set in (42) to a singleton set that only contains (43). They define the minimization operation in (44) which picks up the smallest function from a set of functions.

(44) Let $S$ be a set of functions. Then \( \text{min}(S) = \{ f \in S : \forall g \in S[g \subseteq f \rightarrow g = f] \} \)

Applying minimization to (42) picks up the right singleton set:

(45) \[ \text{min}((42)) = \{ f \in (42) : \forall g \in (42)[g \subseteq f \rightarrow g = f] \} = \{ f \in (42) : \text{dom}(f) = \text{CLAIM}^{Dan,\emptyset} \} = \{ (43) \}\]

Now the definite article can apply to \( \text{min}((42)) \) to derive the desired denotation:

(46) \[ \text{the} \left( \text{min}(42) \right) = \text{if } \{ \text{dom}(f) = \text{CLAIM}^{Dan,\emptyset} \land \forall w \in \text{CLAIM}^{Dan,\emptyset} \left[ f(w) = \text{Dan} \land f(w) \text{ is a gifted-math' in } w \right] \}\]

In words, this function is the unique function from Dan’s CLAIM worlds to Dan, who is a gifted mathematician in those worlds. This is the same meaning G&K derive for the gifted mathematician that Dan claims he is, but using different compositional techniques.

A.2. Combination with the rest of the sentence

For the combination of the subject with the rest of the sentence, we assume that the subject is reconstructed below should at LF, and that it takes as an argument a world variable bound by should, in (47a). The final denotation is in (47b).

(47) The gifted mathematician Dan claims he is should be able to solve this problem
a. LF: Should$^{\emptyset} \lambda w \left[ \text{the } \lambda f \ldots \text{GM} \ldots \right]_w \left[ \text{be-able}_w \text{ to solve this problem} \right] 
   b. \forall w \in \text{SHOULD}^{\emptyset} \left[ f(w) \text{ is able to do solve the problem in } w \right]
   where $f$ is the denotation of the subject (given in (46)), and SHOULD$^{\emptyset}$ is the set of worlds quantified over by should
References


Subjective assertions are Weak: exploring the illocutionary profile of perspective-dependent predicates.1
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Abstract. Sentences containing subjective predicates – e.g., “The movie was awesome” – are intuitively anchored to a particular perspective; this makes them different from sentences describing objective facts – e.g., “The movie was set in 1995”. While authors have long debated on whether this intuition tracks a lexical distinction between subjective and factual predicates, much remains to be explored on whether, and how, the difference between these two assertions is reflected at the illocutionary level. Relying on evidence from two experiments, we show that assertions containing subjective predicates display different discourse behavior from objective assertions. We take these findings to support the idea that SAs should be assigned a special illocutionary profile, unveiling a genuine empirical difference between subjective and factual speech.

Keywords: subjectivity, discourse, assertion, Common Ground.

1. Introduction: Subjectivity and Discourse

Sentences containing subjective predicates – e.g., awesome in (1) – are intuitively anchored to a particular perspective, contrary to sentences describing objective facts (as in (2)).

(1) The movie was awesome. Subjective Assertion
(2) The movie was set in 1995. Factual Assertion

A lively debate in linguistics and philosophy revolves around the best way to model the distinction between subjective and factual predicates at the lexical level. Among extant proposals, it has been suggested that subjective predicates are interpreted relative to a judge (Lasersohn 2005; Stephenson 2007; Stojanovic 2007; Sæbø 2009; for a judge-free account, see Pearson 2013; Umbach 2016); that they involve “first person genericity” (Moltmann 2010); that they share a common semantic core with other subjective expressions like evidentials and epistemic modals (Korotkova 2016); and that, at the same time, they do not constitute a homogeneous class (McNally and Stojanovic 2017).2 Less explored, however, is whether, and how, the distinction between subjective and objective predicates is reflected in the dynamics of the conversation. In the current paper, we take a step forward towards investigating this issue by asking the following question: How do assertions with and without subjective predicates differ in shaping the Common Ground between two conversation partners? Relying on two experiments, we show that assertions with subjective predicates (henceforth SAs) display different discourse behavior from objective assertions (henceforth, OAs): (i) they do not lead to up-

1I would like to thank three SuB anonymous reviewers and the audiences at WCFFL 35, XPrag 4, and the University of Konstanz for insightful comments and questions. All errors are my own.
2For space constraints, providing an exhaustive review of the literature on the semantics of subjectivity goes beyond the scope of this paper. But see van Wijnbergen-Huitink (2016) for an overview.
dating the Common Ground when followed by silent responses; (ii) they do not engender a conversational crisis when targeted by a denial. We take these findings to highlight a genuine empirical difference between subjective and factual speech, suggesting that SAs should be assigned a special illocutionary profile. The paper is structured as follows: Section 2 summarizes the standard view of how OAs and questions shape the Common Ground; Section 3 reviews current proposals of the illocutionary profile of SAs; Section 4 and 5 present the two experiments comparing SAs to OAs with respect to two crucial properties of assertions: the effect of silence responses and the aftermath of denials; Section 6 provides a general discussion of the experimental findings; Section 7 concludes.

2. Preliminaries: Assertions, Questions, Common Ground

Conversation is central to human cognition. As we engage in dialogues with other speakers, we constantly pool our epistemic resources with those of our interlocutors; by doing so, we inch closer to a correct representation of the current world, the ultimate goal along our quest for knowledge. For the purpose of the current paper, I follow two standard ideas concerning the dynamics of this activity. First, we increase our stock of mutual knowledge by constantly establishing and updating the Common Ground (henceforth, CG), the set of worlds compatible with what all conversational participants believe (Stalnaker 1978). Second, different types of speech acts place different constraints on how the conversation evolves and the CG is updated (Farkas and Bruce 2010). A particularly important distinction, in this respect, is the one between assertions and questions, which I now turn to review.

On the one hand, assertions are informative moves; that is, they aim at directly increasing the CG. This idea is captured by modeling assertions as proposals to add the anchor proposition to the CG, which the listener can either accept or reject. Let us consider (2) above again in (3).

(3) The movie was set in 1995.

Assertion

In this view, this assertion has three effects. First, the speaker publicly commits to the proposition “The movie was set in 1995”. Second, the speaker proposes to add $p$ to the Common Ground of the conversation. Third, the interlocutor has the power to either accept the proposal, which effectively amounts to enriching the CG with $p$; or to reject it, which prevents the CG from being modified. Concerning this last effect, it is important to observe that, from a pragmatic perspective, acceptance and rejections are not on a par. While acceptance is the default outcome of an assertion, rejection is a highly marked response, as shown by a crucial piece of evidence: besides affirmative responses, absence of an explicit response on the part of the interlocutor is normally taken to indicate acceptance; by contrast, rejection needs to be overtly signaled by a denial.


a. B: Yes, that’s right! Affirmative response $\rightarrow p$ added to CG
b. B: [silence] No response $\rightarrow p$ added to CG
c. B: No, it isn’t! Denial $\rightarrow p \text{ not} \ added \ to \ CG
On the other hand, polar questions are *inquisitive* moves; they do not aim at directly increasing
the CG, but they request for information, calling on the interlocutor to enrich the CG in the next
conversational turn. Once again, let us examine this with an example:

(5) Was the movie set in 1995? Polar Question

On the standard view, asking $?p$ has three effects. First, the speaker publicly commits to raising
an issue about whether the movie is set in 1995. Second, the speaker proposes to add either $p$
or $¬p$ to the Common Ground. Third, the interlocutor is ultimately requested to decide to shape
how the CG will be updated with their response. Contrary to assertions, however, we do not
observe the same asymmetry between positive and negative responses: since two alternative
proposals have been put forward by the speaker, the interlocutor has to actively choose one of
them; failure to do so, i.e., remaining silent, will not lead to an update in either direction.

(6) A: Is the movie set in 1995?

  a. B: Yes, that’s right! Affirmative response $→ p$ added to CG
  b. B: [silence] $→$ neither $p$ nor $¬p$ is not added to CG
  c. B: No, it isn’t! Denial $→ ¬p$ is added to CG

Building on this distinction, I ask the following: how do SAs shape the procedure whereby the
CG is updated? More specifically: How does the perspective-dependent nature of the predicate
shape the illocutionary force of the assertions that contain them? I first turn to review three
proposals, each of which makes different testable predictions with respect to the discourse
effects of these moves.

3. The illocutionary profile of SAs: current proposals

In light of the substantive amount of work concerned with subjectivity in language, the dis-
course status of assertions like (1) remains surprisingly underexplored. When it comes to the
pragmatic correlates of subjectivity, in particular, most of the literature has focused on cases
in which these forms are embedded under attitude verbs such as “I find that”, or come with
an overt argument specifying the anchor of the judgment. The crucial observation is that in
such cases, contrary to regular assertions, these predicates cannot be challenged, even in case
the interlocutor has a different view/experience on the matter. (7) reports an example from
Stephenson (2007).

(7) Mary: How is the cake?
   Sue: It tastes good to me.
   Sam: # No, it doesn’t! It tastes terrible.

A common view is that, in such contexts, subjective predicates are simply *presentative*: they
merely express an opinion, but effectively fail to make an actual proposal to increase the Com-
mon Ground. This idea is cashed out in different ways: Dechaine et al. (2017) suggest that these
constructions merely update the *Origo Ground*, a discourse space where perspective-dependent
content is represented, and which is distinct from the Common Ground; Umbach (2016) and Stephenson (2007) propose that these moves are simply not made available to the interlocutor for acceptance or rejection.

Less consensus, however, surrounds uses of subjective predicates as in (1), where no anchor is specified. Three accounts, in particular, have been proposed. According to Dechaine et al. (2017), subjective predicates “lexicalize presentative force” independently of whether the anchor is specified or not; as such, both (7) and (1) should be treated as inert with respect to the goal of increasing the Common Ground. According to Umbach (2016), SAs with no explicit anchor or no embedding attitude verb are interpreted as assessments tout court: similar to regular assertions, they do aim at increasing the CG and, once asserted, wait for confirmation or denial, in the same way in which an objective statement would. Finally, Stephenson (2007) suggests that assertions like those in (1) are associated with an autocentric norm of assertion: p can be asserted as long as the speaker judges it to be true; however, it is only added to the CG if all participants in the conversation judge it as true (see Coppock 2018 for a variant couched within the framework of outlook semantics). On this view, the norm of assertion of SAs is distinctively weak: a speaker can legitimately make these without having any expectation that the interlocutor will share the same view, and thus that the proposition will end up being added to the Common Ground. This contrasts with OAs, which, barring exceptional circumstances, normally require that the speaker expects that the asserted proposition will be accepted. At the same time, SAs are still proposals that are aimed at enriching the CG, and that can be either accepted or rejected by the interlocutor. The emerging picture is one in which the view that SAs rely an autocentric norm of assertion occupies a middle ground between the other two views presented above: they do not encode acceptance of p as their default outcome, similar to what is predicted by the view that they are presentative moves; but they are nevertheless inscribed in the participants’ project of enriching the CG, similar to the view that they are assessment tout court. I now proceed to test the predictions of these proposals experimentally, comparing the behavior of SAs, OAs and PQs with respect to two distinctive parameters of assertions: the effects of silent responses, and the aftermath of denials.

4. Experiment 1: the effect of silent responses

In this study, I explore the behavior of SAs with respect to silent responses. As can be recalled from the discussion in Section 2, adding p to the CG represents the unmarked outcome of an assertion (see e.g., Stalnaker 1978, Farkas and Bruce 2010). As such, while rejection needs to be overtly signaled with a denial, silence typically leads accepting the proposal, on a par with an explicit affirmative reply. By contrast, because Polar Questions do not make a univocal proposal, they require an explicit response from the interlocutor for the CG to be updated. Concerning Subjective Assertions, each of the three accounts above make different predictions. If SAs work like regular assertions, they should put forward a proposal in the same way in which OAs do: on this view, silent responses should likewise lead to updating the CG with p. If SAs are merely presentational, no proposal is made at all: this predicts that silent responses should not lead to update the CG. Finally, if SAs rely on a weak norm of assertion, an explicit response should be required from all participants before an update is made: this, again, predicts that silence should not be interpreted as a sign of acceptance of the proposition.
4.1. Methods

4.1.1. Design

Two factors were crossed in a 3x3 design. Each trial consisted of a written dialogue in which Greg makes one of three possible moves – OA, SA or Polar Question (PQ) – and Mary provides one of three possible responses – Confirmation, Denial or Silence. Following each dialogue, participants were asked to assess whether, according to what they had just read, the proposition was part of the participants’ Common Ground. The assessment was operationalized on a 1-7 Likert scale (7=“totally agree”; 1= “totally disagree”) response to the statement “It is now part of Greg and Mary’s mutual knowledge that \( p \)”. The higher the score, the higher the likelihood that the update went through according to the participant. (8) illustrates a sample dialogue.

(8)  
\[ \text{Greg: OA: The movie was awesome.} \]
\[ \text{Greg: SA: The movie was set in 1995.} \]
\[ \text{Greg: PQ: Was the movie set in 1995?} \]
\[ \text{Mary: Confirm: Yes, indeed!} \]
\[ \text{Mary: Denial: No, not really!} \]
\[ \text{Mary: Silence: [Keeps listening, says nothing.]} \]

Statement to assess: “It is now part of G and M’s mutual knowledge that \{The movie was awesome/the movie was set in 1995\}.”

4.1.2. Procedure and Statistical analysis

27 items, each with a different set of predicates, were distributed in 9 lists with a Latin Square Design. Each list was completed by 26 fillers. All fillers consisted of dialogues between Greg and Mary, where Greg would ask a Wh-Question, and Mary would provide a response. 54 self-declared native speakers of American English were recruited on MTurk and paid $1.50 for participation. 3 subjects were excluded due to missing responses. For statistical analysis, a mixed-effects model was run with the responses as the dependent variable, fixed effects for Move and Response and random slopes for Subjects and Items. The models were run with the \textit{lme4test} in R (Kuznetsova et al. 2016). Given the theoretical motivation of the study, a crucial comparison is the one between OAs, SAs and PQs in silent responses. No difference should be observed for these moves with the other responses: while all confirmations should lead to adding \( p \) to the CG, all denials should not lead to updating the CG with the proposition. OAs and Confirmation were entered as reference levels in the model.

4.2. Results

The results are plotted in Figure 1 below.

Table 1 reports the results of the model.
The model reveals two main effects of Response, as well as two interaction effects Move:Response. To better understand these results, we carried post-hoc comparisons with the application of a Tukey correction for multiple comparisons. We are especially interested in comparing the ratings associated with PQs, SAs and OAs in the presence of silent responses. The analysis reveals that SAs significantly differ from both OAs ($t(22.57)=5.4$, $p < .001$) and PQs ($t(22.57)=5.4$, $p < .001$). No significant difference is found between these three moves following either confirmations or denials.
4.3. Discussion

In Experiment 1, we explored how different responses to PQs, SAs, and OAs affect CG updates. As predicted, confirmations lead to adding the proposition to the CG across moves, while denials blocked CG updates across moves. The three moves, however, behave differently when followed by silent responses. In particular, following OAs, silence leads to updating the CGs to a considerably greater extent than for SAs, suggesting that, in the presence of subjective predicates, adding $p$ to the CG is less of a default outcome than it is for assertions containing factual predicates. At the same time, the CG-acceptance rating for silence following SAs is higher than for PQs, suggesting that SAs still retain some kind of assertive force with respect to plain questions.

5. Experiment 2: the aftermath of denials

In Experiment 2, we compare SAs and OAs with respect to another distinctive property of assertions: the aftermath of disagreement. Let us consider these two examples.

(9) a. A: The movie was set in 1995.
   B: No, it wasn’t!
   b. A: The movie was awesome.
   B: No, it wasn’t!

On the one hand, there is consensus that disagreement following an objective statement tends to be highly disruptive for the conversation. First, it undermines the felicity of the assertion itself, implying that the speaker is not using language in a congruous way. Second, it creates a situation of conversational crisis, where the two interlocutors have incompatible commitments, and the CG ends up being an absurd belief state. As a result, this situation needs work to be solved: it can be sorted out via retraction, for example, or via a mutual negotiation to leave the issue unsettled and “agree to disagree” (Farkas and Bruce 2010). This experiment directly compares SAs and OAs on this basis by operationalizing and measuring the actual degree of disruptiveness of disagreement following each of these moves. Specifically, the study compares the perceived naturalness of two types of reactions to a denial: “Aha, interesting to hear!”, which signals a welcoming disposition towards disagreement; and “No way! That can’t be true”, which signals willingness to react to the denial. Following the idea that denying assertions leads to a conversational crisis, insisting responses should be rated as more natural than welcoming reactions to denials following OAs. By contrast, for a “No” answer directed at a question, a welcoming response should be more natural than an insisting one to be inappropriate, since questions do not put forward proposals in the first place. Concerning subjective predicates, different theories make divergent predictions. If SAs have mere presentational force, no proposal for the CG is put forward: as such, insisting responses on the part of the speaker should be rated as unnatural as insisting responses following denials to questions; by contrast, welcoming responses should be rated as natural as welcoming responses following denials to questions. If SAs behave like regular assertions, insisting responses should as natural as they are for OAs, while welcoming responses should be as unnatural. Finally, if SAs are linked to a weak norm of assertion, both types of responses should have intermediate naturalness:
welcoming responses should be more natural than they are for OAs, since disagreement does not undermine the felicity of the assertion that it targets; at the same time insisting responses should also be natural than they are for question, since a proposal for the CG is still put forward, motivating the speaker’s effort to push the assertion further.

5.1. Methods

2 factors were crossed in a 3x2 design. Each trial consisted of a written dialogue in which Greg makes one of three moves (OA, SA or a PQ); Mary responds with a denial; and Greg follows up with one of the two reactions above. Subjects provided a 1-7 naturalness judgment (1=“totally unnatural”; 7=“perfectly natural”) on the final reaction. An example is below.

(10)  
Greg: **SA:** The movie was awesome.  
Greg: **OA:** The movie was set in 1995.  
Greg: **PQ:** Was the movie set in 1995?  
Mary: No, it was not!  
Greg: **Welcoming:** Aha, interesting to hear!  
Greg: **Insisting:** No way! That can’t be true!

How natural does the underlined part sound? “1. . . . . . 7”

5.2. Procedure and statistical analysis

18 items were distributed in 6 lists with a Latin Square Design, together with 20 fillers. 54 self-declared native speakers of American English were recruited on MTurk and paid $1.50 for participation. 1 subject was excluded due to missing responses. To ensure that welcoming and insisting replies were perceived as such, subjects were explicitly instructed to assume that Greg was not being sarcastic. For statistical analysis, a mixed-effects model was ran with the responses as the dependent variable, fixed effects for Move and Response and random slopes for Subjects and Items. The models were ran with the `lmerTest` in R (Kuznetsova et al. 2016). OAs and Insisting were entered as reference levels in the model.

5.3. Results

The results for Experiment 2 are plotted in Figure 2 below.
The results from the mixed-effects model for Experiment 2 are reported in Table 2 below.

Table 2: Mixed effect model summary for positive attributes. Intercept: OA & Insisting

<table>
<thead>
<tr>
<th>Factor</th>
<th>Coefficient</th>
<th>Standard Error</th>
<th>t-value</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>5.87</td>
<td>0.18</td>
<td>31.1</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>PQ</td>
<td>–1.72</td>
<td>0.21</td>
<td>–8.3</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>SA</td>
<td>–1.91</td>
<td>0.20</td>
<td>–9.4</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>Welc</td>
<td>–2.71</td>
<td>0.23</td>
<td>–11.6</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>PQ:Welc</td>
<td>4.25</td>
<td>0.23</td>
<td>17.8</td>
<td>&lt;.0001</td>
</tr>
<tr>
<td>SA:Welc</td>
<td>3.80</td>
<td>0.13</td>
<td>15.9</td>
<td>&lt;.0001</td>
</tr>
</tbody>
</table>

All main effects and interactions are significant. To better understand the interactions, post-hoc comparisons with the application of a Tukey correction for multiple comparisons were carried out. As far as the contrast between welcoming and insisting responses, insisting responses were rated higher than welcoming ones for OAs (t(32.3) = 11.6, p < .0001); for SAs and PQs, instead, welcoming responses were rated higher (For SAs, t(32.3) = 4.6, p < .001; For PQs, t(32.3) = 4.5, p < .001). As far as the contrast between different types of moves, welcoming responses were rated higher for SAs than for OAs (t(20.0) = 9.2, p <.0001), and were rated higher for PQs than for either SAs or OAs (PQs vs SAs: t (20.0)= 3.1, p < .05; PQs vs OAs: t (20.0)= 11.2, p < .0001). Conversely, insisting responses were rated higher following SAs than following PQs (t(27.5) = 4.2, p <.01), and were rated higher following OAs than following either SAs or PQs (OAs vs SAs: t(20.0) = 9.4, p < .0001; OAs vs PQs: t(34.2) = 8.3, p < .0001).
5.4. Discussion

These findings suggest that disagreement targeting SAs behaves differently than disagreement aimed at OAs. Insisting responses and welcoming responses are rated respectively higher and lower for SAs than for OAs; in addition, within SAs, welcoming responses are rated higher than insisting ones, while the reverse is the case for OAs. The emerging picture is one in which denials targeting SAs come with a degree of disruption that is lower than the one associated with OAs, and yet higher than the one associated with PQs. This suggests once again that assertions containing subjective predicates occupy a middle ground between polar questions and regular assertions.

6. General Discussion

The findings from these two studies suggest that, from an empirical perspective, the illocutionary behavior of SAs is different from the one of OAs. Two differences are supported by the experimental results. First, as shown in Experiment 1, SAs do not lead to an update of the CG with \( p \) in the absence of an overt response. Second, as shown by Experiment 2, denials following SAs are less disruptive – i.e., more likely to be accepted and less likely to be resisted – than denials following OAs. With respect to both these properties, the behavior of SAs is remarkably similar to that of questions. In particular, both PQs and SAs appear to require some sort of explicit response before a proposition is added to the CG; and both SAs and PQs do not engender a conversational crisis when followed by denials. At the same time, the profile of SAs remains different from the one of questions: when followed by a silent response, SAs still lead to update the CG to a higher extent than PQs; and in the aftermath of denials, it is still more natural for authors of SAs to defend the proposition than it is for authors of PQs. Taken together, these observations suggest that OAs and SAs are empirically distinct moves from the perspective of discourse. In particular, with respect to both properties that were tested the behavior of SAs is consistent with the idea that SAs rely on a weaker norm of assertion, where a speaker utters the proposition as long as they judge it to be true, but the proposition is added to the CG only if all discourse participants share the same evaluation: this would explain the absence of default acceptance in case of silence, as well as the mild flavor of disagreement in case of denials.

Looking at the broader picture, two questions arise. First, how should SAs be modeled within a formal theory of speech acts and discourse moves? At the very least, the observed behavior of these statements suggests that SAs present significant overlap both with OAs and PQs, two moves that are located at opposite ends of a spectrum (see Section 2). This intuition could be cashed out by suggesting that SAs are effectively a hybrid type of speech act. Similar to OAs, they are informative: they require the speaker’s commitment to the anchor proposition, as they present a proposal that is supposed to directly enrich the CG. Similar to PQs, however, they are inquisitive: they raise the issue as to whether the interlocutor also judges the proposition as true, explicitly requesting for an explicit stance on this issue before the CG can be updated. This idea could be captured by positing that SAs obtain the two following effects whenever they are uttered by a Speaker A in a conversation with Speaker B. In the notation above, \( p_A \) and \( p_B \) refer to \( p \) as judged by Speaker A and Speaker B respectively.
• **Informative part**: A publicly commits to \( p_A \) (≈ OAs)

• **Inquisitive part**: A proposes to update the CG by raising the issue \( ?p_B \) (≈ PQs)

• **Update procedure**: the CG is updated with \( p_{AB} \) if and only if the interlocutor agrees

If this is the illocutionary profile of SAs, it becomes possible to explain why a response from the interlocutor is always needed, and why disagreement isn’t disruptive. A negative response, under this account, is not a rejection of the speaker’s proposal, but merely a way of choosing one of two available options, just like it normally happens with polar questions. As a further empirical observation, it can be noted that SAs, similar to PQs, license response particles like *totally* or *yes!*, suggesting that they indeed raise an issue that can be addressed by the interlocutor. The status of such responses appears to be degraded with OAs (Beltrama 2018).

(11) A: The movie was awesome.
B: Totally!

(12) A: The movie was set in 1995.
B: #Totally!

While I leave the proper formulation of this idea to further research (but see Beltrama 2018 for a preliminary attempt), it is important to point out that, if correct, this proposal highlights SAs as a further instance of speech act with declarative syntax and idiosyncratic discourse profile, on par with raising declaratives (Jeong, to appear; Rudin 2018) or declaratives modified by tags (Malamud and Stephenson 2014). As such, modeling the illocutionary profile of SAs could crucially contribute to enriching our understanding of the land in between assertions and questions, informativity and inquisitiveness, a territory that remains relatively uncharted in the study of discourse.

A second theoretically relevant question is the following: How do the properties of SAs highlighted in these studies shed light on the debate concerning the representation and interpretation of subjective predicates? A particularly contested notion in this literature revolves around the nature of disagreement following perspective-dependent expressions. According to some authors, subjective predicates give rise to the phenomenon commonly labeled as *faultless disagreement* (Kölbel 2002, Lasersohn 2005, Stephenson 2007). On this view, disagreement is seen as much less disruptive than with OAs: although the interlocutors are producing conflicting assertions, neither of them is saying something false, or making a pragmatically infelicitous move. Other authors, however, question the very existence of faultless disagreement altogether, suggesting that disagreement following subjective predicates is not distinct from genuine, factual disagreement (Stojanovic 2007; Umbach 2016); on this view, the intuition that no participant is blameworthy is a misconception arising from the fact that, when such predicates are used, a general perspective on the CG is not available to the speakers. While Experiment 2 was not designed to provide support in favor or against either view, it is worth observing that the non-disruptive flavor of disagreements following SAs can be accounted for rather straightforwardly under a view in which these are disputes are genuinely faultless, and thus distinct
from those about objective matters. By contrast, explaining this result in light of the competing view would instead require a more complex explanation – e.g., one that links the lack of disruptiveness of denials to more general pragmatic principles about reasoning with evaluative meanings, and not to their status as speech acts with distinctive properties. In sum, while the findings from the second study cannot provide conclusive evidence supporting either view of the nature of disagreement, they do highlight experimental methods as a potentially viable technique to cast light on this debate, as well as on other theoretical issues related to the encoding of subjectivity in language (see Solt 2018; Kaiser and Lee 2018 for recent approaches).

7. Conclusion

The two studies discussed in the paper suggest that the distinction between subjective and factual language is empirically reflected in the way in which different types of assertion shape discourse. As such, these findings raise a number of questions concerning the modeling of the pragmatic and discourse correlates of subjective language. While providing an answer to these issues would go beyond the scope of the current paper, it is my most sincere hope that these results, together with the discussion provides above, can be a useful starting point for further research on a seminal topic across linguistics and philosophy.

References

Subjective assertions are weak

tics 30(1), 103–154.
Decomposing cornering effects: an experimental study
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Abstract. Alternative Questions with “or not” (NAQ) convey a cornering effect, which is not found with they polar counterparts (PQ). This effect has been claimed to consist of two parts (Biezma 2009): NAQs (i) cannot be used discourse-initially and (ii) they do not license follow-up questions/subquestions. In this paper, we ask the following: Are both parts of cornering linked to the same property of NAQs? Or do they reflect distinct linguistic phenomena? We explore the issue by comparing the behavior of NAQs to Complement Alternative Questions (CAQ), a type of question that, like NAQs, presents logically opposite alternatives but, unlike NAQs, fully spells out the second one. Results from two experiments suggest that both parts of cornering can instead be explained in terms of independent semantic and pragmatic principles, which operate beyond the domain of alternative questions.

Keywords: Alternative Questions, cornering, discourse, focus, information structure.

1. Introduction: the Cornering Effect

Questions with seemingly similar semantic content have significantly different pragmatic properties. In particular, Bolinger (1978) observed that Polar Questions (henceforth, PQs) tend to have a broader distribution than Negative Alternative Questions, that is, their alternative counterparts with “or not” (henceforth, NAQs). For example, PQs have been reported to be more felicitous than NAQs in many non-canonical uses—e.g., when used to make invites, draw inferences, or pose rhetorical questions. In addition, Biezma (2009) observes that, in information-seeking uses, NAQs induce a cornering effect, whereby they put the discourse in a ’cul de sac’ (Biezma 2009), pressing the hearer to provide an answer. According to Biezma, the cornering effect can be broken down into two distributional restrictions. First, NAQs are inappropriate discourse-initially, as shown in the following example.

(1)  Cornering, Part 1
Scenario: You are in charge of coordinating the cooks for the colloquium dinner. John is one of the cooks. Dinner is tomorrow and you need to know what is happening with the pasta.
You: # Are you making pasta or not?  NAQ

We would like to thank Maria Biezma, Doris Penka, Ramona Wallner, three SuB anonymous reviewers, and the audiences at PLC, CLS, and the Ohio State Pragmatics reading group for insightful comments and questions. All errors are our own.

Second, NAQs are necessarily discourse-final, that is, they do not license followup questions/subquestions.

(2) **Cornering, Part 2**

**Scenario:** You are in charge of coordinating the cooks for the colloquium dinner. John is one of the cooks. Dinner is tomorrow and you need to know what is happening with the pasta.

**You:** Are you making pasta?

**John:** (Silence and dubitative faces)

**You:** /checked Are you making pasta or not?  
**John:** (Silence and dubitative faces)

**You:** # Are you making pasta?

It follows from these restrictions that NAQS are only felicitous in a context in which a question has already been asked before, and no other question follows it. Note that in this exchange a PQ is used discourse initially, and is followed by another question; this shows that neither component of cornering applies to it. In this paper, we address two interrelated questions: What is the underlying source of each part of the cornering effect? And are the two components of cornering independent from one another? Relying on two experiments, we aim to tease apart the following two possibilities in particular. One possibility is that cornering is driven by certain distinctive properties of NAQs, as suggested by two separate accounts in the literature; the other possibility is that cornering is driven by more general pragmatic principles underlying information structure and discourse, which apply beyond NAQs. To cast light on the issue, we will compare the behavior of PQs and NAQs to Complement Alternative Questions (henceforth, CAQs), a variety of question that poses two logically opposite alternatives, but spells out the second disjunct with a complementary antonym, as opposed to via negation.

(3) a. Is it a boy or a girl?
   b. Is it heads or tails?

Based on the results from our studies, we will suggest that Part 1 of cornering is linked to a particular focus structure which penalizes discourse-initial uses of questions in general; and that Part 2 is driven by a broader pragmatic principle that penalizes reusing a question that didn’t previously work. The emerging picture is one in which each part of cornering is derived independently, and can be derived through constraints that apply beyond the narrow domain of NAQ.

The paper is organized as follows. In Section 2 we review two current accounts of the two components of the cornering effects: Biezma’s (2009) exhaustivity/exclusivity-based analysis and Biezma and Rawlins (2014, 2018)’ bundling-based analysis. In Section 3 we outline a third possibility to account for cornering. In Section 4 we introduce CAQs as a case study and outline our hypotheses. In Section 5 and 6 we describe the two experiments. In Section 7 we provide a general discussion of the findings from the study. In Section 7 we conclude.
2. Cornering and NAQs: hypothesis

2.1. Biezma 2009

Biezma (2009) argues that both parts of cornering track a semantic difference between the denotation of NAQs and PQs. Specifically, she argues that PQs denote an open list of alternatives, which contains \( p \) and other unmentioned alternatives salient in discourse; alternative questions at large, by contrast, denote two exhaustive, mutually exclusive alternatives \( \{p, q\} \). What makes NAQs special, among alternative questions, is that they present *logically opposite* alternatives, that is \( \{p, \neg p\} \). By virtue of this semantic property, NAQs necessarily exhaust the possibility space in discourse, presenting the hearer with no option other than picking one of the two proposed alternatives. These properties have two consequences for the distribution of these questions. On the one hand, they are an overly strong strategy to begin a conversation, explaining their infelicity in discourse-initial position. On the other hand, they can only be resolved with an answer, ruling out follow up questions or other inquisitive strategies. This explains their necessarily discourse-final position. By contrast, PQs, by virtue of denoting an open list, do not corner the addressee. Since they leave open plenty of options other than the mentioned one, they are adequate to start a conversation and they can be followed by further questions.

2.2. Biezma and Rawlins 2014, 2018

In subsequent work, Biezma and Rawlins (Biezma and Rawlins 2014, 2018) integrate Biezma’s (2009) analysis of cornering by introducing the notion of *bundling*. In the authors’ account, bundling refers to the particular strategy that a speaker adopts for “packaging” the available alternatives when asking a question. For example, in the following exchange, the speaker changes their inquisitive strategy turning a WH-Question into a PQ, bundling an open set of alternatives—i.e., “places for lunch”—into the category of “vegetarian places”.

(4) Question 1: Where should we go for lunch? Wh-Q

... Question 2: Should we go to a vegetarian place? PQ

The authors, specifically, argue that every bundling choice made by a speaker is subject to a *Qualitative Constraint*: there must be some reason to group alternatives together as a strategy in a particular way, distinct from prior discourse. Combined with NAQs’ semantic properties, such a constraint is precisely what explains the two components of cornering. Let us consider the following example again.

(5) **Scenario:** You are in charge of coordinating the cooks for the colloquium dinner. John is one of the cooks. Dinner is tomorrow and you need to know what is happening with the pasta.

**You:** Are you making pasta?
John: (Silence and dubitative faces)
You: √ Are you making pasta or not?

Here, following the initial PQ, the use of a NAQ re-organizes the logical space around $p$, bundling any alternative to it under $\neg p$. Per the Quality Constraint, the only possible reason to re-organize the logical space of discourse in this way is the following: $p$ must already be the prominent alternative in discourse. This requirement derives the two components of cornering. Concerning the ban in discourse-initial position, for $p$ to be already prominent in discourse it must be the case that the interlocutors have accepted a bias for $p$—that is, that $\neg p$ has been asked before. Crucially, this constraint is not met in discourse-initial questions, explaining Part 1 of cornering. Concerning Part 2 of cornering, NAQs cannot be subject to further bundling; that is, no bundling strategy that is more informative is available to the speaker once a NAQ has been asked, making any further inquisitive strategy irrelevant. This explains NAQs’ necessarily discourse-final status.

Note that, on this account as well, PQs are correctly not predicted to give rise to cornering. Since their denotation includes further, unmentioned propositions beyond the mentioned one, the use of this strategy does not induce a situation in which the entire logical space is organized around $p$. Because of this, PQs do not presuppose that $p$ is already prominent in discourse, avoiding part 1 of cornering; and they can be followed by more informative bundling strategies, such as NAQs indeed, avoiding part 2.

The emerging picture is one in which the cornering effect can be explained via two alternative accounts: one based on exhaustivity/exclusivity, as per Biezma (2009); and one based on a combination of exhaustivity/exclusivity and bundling, as per Biezma and Rawlins (2014, 2018). Since they aim at explaining the same data, however, these proposals cannot be teased apart by merely looking at the behavior of NAQs in comparison to PQs. In the remainder of the paper, we thus aim to assess them by looking at Complement Alternative Questions, a type of question that, as we turn to explain shortly, presents itself as a suitable case study to compare the suitability of these two accounts. Before proceeding any further, however, we want to introduce a third possibility: Both Part 1 and Part 2 of cornering might be related to independent semantic/pragmatic principles, which apply besides the domain of NAQs, and just happen to coalesce in this particular construction. We now turn to discuss this hypothesis in greater detail.

2.3. A third hypothesis: Cornering as an effect of independent principles

Both accounts suggest that both Part 1 and Part 2 of cornering are linked to the same underlying phenomenon; that is, in both views, the two restrictions on the distribution of NAQs are seen as grounded in the properties that distinguish this type of inquisitive strategy from other ones. We suggest that, at least in principle, an alternative hypothesis ought to be entertained: each part of cornering could be the result of independent pragmatic principles, and thus explained independently from the other. In particular, we suggest that Part 1 could be grounded in the interaction between focus and information structure. Specifically, we observe that infelicity in
discourse-initial position is not found only with NAQs, but, more generally, with questions with focus on the polarity. The contrast below shows this for PQs with the focus on the auxiliary, as opposed to on the property (?, Lohnstein 2012).^2

(6) **Speaker A**: Jane had a baby!
   a. **Speaker B**: Is it a BOY? 
   b. **Speaker B**: #IS it a boy?

Crucially, NAQs precisely present two opposite polar values as disjuncts. As such, following the generalization that all alternative questions mandatorily place main focal stress on the disjuncts (Bartels 1999, Truckenbrodt 2013), they necessarily have focus on the polarity, similar to (6b) above.

(7) **Speaker A**: Jane had a baby!
    **Speaker B**: Is it a boy (yes) or not? Focus on the polarity

As such, concerning Part 1 of cornering, the additional hypothesis that should be considered besides those outlined above is the following: to the extent that focus on the polarity blocks the use of an interrogative clause at the beginning of a conversation, this factor could stand behind NAQs’ infelicitous in discourse-initial position.

Similarly, Part 2 of cornering—that is, the necessarily discourse-final status of NAQs—could also be explained via an independent principle. Let us consider the crucial piece of data again.

(8) **Cornering, Part 2**
    **Scenario**: You are in charge of coordinating the cooks for the colloquium dinner. John is one of the cooks. Dinner is tomorrow and you need to know what is happening with the pasta.
    **You**: Are you making pasta?
    **John**: (Silence and dubitative faces)
    **You**: # Are you making pasta or not?
    **John**: (Silence and dubitative faces)
    **You**: # Are you making pasta?

Our hypothesis is that the infelicitous status of the final PQ might be driven not by the preceding NAQ, but by the fact that a PQ had already been asked with no success beforehand. Specifically, following a standard view of discourse moves as strategic attempts to solve a salient Question

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^2Focus accent on a tense verb may express, among other things, focus-marking on the polarity as in (i), verum focus as in (ii) (Höhle 1992) or so-called ‘dictum’ focus as in (iii) (Creswell 2000). Since (6b) with focal stress on the tense verb is infelicitous in the given context, none of these three uses is licensed discourse-initially. In this paper, the polarity focus use will be most relevant.

(i) John arrived. Bertha DIDn’t.
(ii) A: Rumor has it that Alan finished his dissertation.
    B: HE Finished his dissertation.
(iii) A: Are we going to the party?
    B: Right! ARE we going?
Under Discussion (Roberts 2012 among others), we suggest that speakers should not resort to strategies that already proved unsuccessful to solving the QUD in the previous turns. Doing so would result in pragmatically irrational behavior, since it would amount to adopting a strategy that, in light of what happened in the previous stages of the conversation, is very likely to fail. We summarize this idea in the *Repeat principle, a conversational constraint that applies to discourse moves across the board. On this view, Part 2 of cornering would be orthogonal to the properties of NAQs, resulting instead from this more general principle.

(9)  **Repeat**: Do not resort to a discourse move that already proved unsuccessful

2.4. Interim summary

In this section, we have entertained three different hypothesis concerning the source of the two parts of the Cornering Effect: two of them are drawn from the previous literature; the third one has been formulated as part of the current investigation.

- **Hypothesis 1**: Both parts of cornering derive from logical exhaustivity/exclusivity (Biezma 2009);

- **Hypothesis 2**: Both parts of cornering derive from bundling around \( p \) plus logical exhaustivity/exclusivity (Biezma and Rawlins 2014, 2018);

- **Hypothesis 3**: Each part of cornering derives from an independent pragmatic principle (additional hypothesis)

3. CAQs: a testbed to test the hypothesis

We suggest that a viable case study to adjudicate these possibilities is represented by Complement Alternative Questions (CAQ), a type of alternative question that, similarly to NAQs, pronounces two logically opposite alternatives; but, contrary to NAQs, spells out the second alternative in full, as opposed to with ”or not”. (10) reports two examples.

(10)  a. Is it a boy or a girl?
      b. Is it heads or tails?

Crucially, each of the hypotheses outlined above makes different predictions concerning the behavior of CAQs with respect to the two components of the Cornering Effect.

If, as Hypothesis 1 suggests, cornering is linked to the fact that the disjuncts exhaust the epistemic space of in discourse, CAQs should also feature both parts of the effect, since they likewise pose logically opposite alternatives. On this view, we predict that CAQs should behave exactly like NAQs with respect to both restrictions outlined above.

If, as Hypothesis 2 suggests, cornering is driven by the strategy to bundle the alternatives around
$p$, then CAQs should feature neither part of the effects. Since they spell out the second disjunct with a full proposition, they do not presuppose that the speakers already accepted a bias for $p$ in discourse; and they can be followed by more informative bundling strategies in the continuation of the conversation. On this view, we predict that CAQs should diverge from NAQs with respect to both restrictions.

Finally, concerning Hypothesis 3, we predict that CAQs and NAQs should behave differently from NAQs with respect to Part 1, and that neither CAQs nor NAQs should be necessarily discourse-final, as long as the question that follows them has not been used yet in the previous discourse. Let us unpack both predictions made by this account before proceeding any further. Concerning Part 1, this hypothesis suggests that the ban of NAQs in discourse-initial position is linked to that fact that they necessarily have focus on the polarity, a constraint that typically makes interrogative clauses infelicitous in the beginning of a conversation. But CAQs, contrary to NAQs, spell out two fully distinct propositions, as opposed to a proposition and its negated counterpart. As such, following the generalizations that all alternative questions necessarily have focus on the disjuncts, they have focus on such two propositions, and not on polarity, as illustrated below. If focus on the polarity is what determines Part 1 of cornering, it follows that NAQs should not be felicitous discourse-initial, while CAQs should be immune to this restriction.

(11)  
  a. Is it a boy$_F$ or a girl$_F$? Focus on the property  
  b. Is it a boy (yes$_F$) or not$_F$? Focus on the polarity

Concerning Part 2, Hypothesis 3 suggests that the infelicity of PQs as a follow up to a NAQs is not due to the preceding NAQ per se; rather, it stems from the infelicity of repeating the PQ again, after it had been used in the beginning of the exchange. On this view, we expect that, independently of what we see for Part 1, both NAQs and CAQs should fail to license a follow-up question that was previously unsuccessful; and they should both be able to be followed by follow-up questions that hadn’t been used yet.

We now turn to test these hypotheses in two experiments. Experiment 1 compares these three hypotheses with respect to Part 1 of cornering; Experiment 2 is concerned with comparing these possibilities with respect to Part 2.

4. Experiment 1: CAQs and NAQs in discourse-initial position

In this study, we compared the distribution of NAQs, CAQs and PQs in discourse-initial position. Our goal is to assess the predictions of our three hypothesis concerning the source of Part 1 of the Cornering Effect, that is, the infelicitous status of NAQs at the beginning of a conversation. As can be recalled, the three possibilities outlined above make the following prediction with respect to this restriction: Hypothesis 1 predicts that both NAQs and CAQs, by virtue of exhausting the possibility space, should be infelicitous discourse-initially; Hypothesis 2 and 3 predict that only NAQs should be infelicitous in this context, while CAQs should sound natural.
4.1. Methods

4.1.1. Design

Two factors were crossed in a 2x3 design. Each trial consisted of a dialogue, at the end of which one participant would ask a question. The first factor manipulated the moment of the dialogue in which the question is asked, with two levels: ask for the first time, in which the question is asked discourse-initially; and ask-again, in which the question is asked for the third time, after the first two attempts failed to elicit a response. The second factor manipulated the type of question and came in three levels: PQ, NAQ, and CAQ.

(12) a. **Ask first-time**
   
   **Context:** Mary runs into Greg on the street. It’s been one year since they last saw each other, so they want to catch up:
   
   Greg: Hey, what’s new?
   
   Mary: I just got a puppy!
   
   Greg:
   
   Oh, is it a male? PQ
   
   Oh, is it a male or not? NAQ
   
   Oh, is it a male or a female? CAQ

b. **Ask-again**

   **Context:** Mark checks in at a hotel. After the receptionist hands him the keys, the following exchange ensues:
   
   Receptionist: Sir, would you like to have breakfast directly served in your room?
   
   Mark: Is there a charge for it?
   
   Receptionist: It’s a great service. Our customers love it.
   
   Mark: Ok, but is there a charge for it?
   
   Receptionist: You can also order food from the special menu.
   
   Mark:
   
   Is there a charge for it? PQ
   
   Is there a charge for it or not? NAQ
   
   Is there a charge for it or is it free? CAQ

4.1.2. Procedure and Statistical analysis

Each subject saw 24 experimental items, 12 for the ask-first-time context and 12 for the ask-again context, plus 24 fillers. The conditions were crossed in a Latin Square Design. 48 participants were recruited on Mechanical Turk and paid $1.50 for participation. 2 participants were excluded as they failed to complete the task. At the end of each trial, participants were asked to answer the following question with a value between 1 and 7: “How natural does the question sound in light of the goal of the speaker? “1” indicated a completely unnatural
question; “7” indicated a perfectly natural question. All items were presented in written form on a screen. As in the first experiment, we ran separate mixed-effects models on the ratings of questions asked for the first time and asked again, with Question Type as the fixed effect and random intercepts for Subjects and Items. Again, the models were ran with the `lmerTest` package. Given the theoretical motivation of the study, we are especially interested in the comparison between NAQ and CAQ for each moment of the dialogue in which the question was asked. In light of this, we opted to establish NAQs as the reference level.

4.2. Results

The results are plotted in Figure 1 below.

As predicted, the control condition turned out to be highly infelicitous across the board. We therefore removed it from the analysis. Remarkably, CAQs and NAQs patterned differently across these two contexts. When the question was asked for the first time, CAQs were rated higher than NAQs ($\beta = 2.01$, SE = 0.28, $p < .0001$); when the question was asked again, instead, no difference emerged between NAQs and CAQs ($\beta = -0.18$, SE = 0.14, $p = .2$). Concerning the contrast between PQs and NAQs, we observe that PQs were significantly better than NAQs when the question was asked for the first time ($\beta = 1.78$, SE = 0.32, $p < .0001$); by contrast, NAQs were better than PQs when the question was being asked again ($\beta = 0.48$, SE = 0.17, $p < .01$).

4.3. Discussion

In Experiment 1, we compared the distribution PQs, NAQs and CAQs discourse-initially. Replicating Biezma’s observations, NAQs appear to be felicitous only when used to ask a question again, while they are infelicitous discourse-initially. By contrast, CAQs show remarkable
flexibility across discourse-initial and non-discourse-initial uses, featuring equal naturalness in both contexts. Crucially, these findings do not support the predictions of Hypothesis 1—that is, that CAQs, by virtue of posing logically opposite alternatives, should also induce cornering. However, the questions remain open as to whether the observed restrictions on NAQs are tied to their distinctive bundling effects, as per Hypothesis 2; or by the combined effect of information structure in interrogative clauses and the *Repeat pragmatic principle, as per Hypothesis 3. To tease apart these two possibilities, we now proceed to compare NAQs and CAQs in discourse-final contexts.

5. Experiment 2

Hypothesis 2 predicted that NAQs, by bundling all discourse options around $p$ or the negation thereof, should feature both parts of cornering, and thus have necessarily discourse-final status; CAQs, by adopting a completely different bundling strategy, should feature neither part of cornering, and thus be able to license follow up moves. By contrast, Hypothesis 3 predicted that the seemingly necessary discourse-final status of NAQs is an epiphenomenon of a pragmatic constraint penalizing repeated uses of a discourse strategy that didn’t work. As such, NAQs and CAQs should pattern together with respect to Part 2 of cornering: both should be able to license follow up questions when the subsequent move has not been used before; but neither should be able to license follow up questions when the subsequent move has already been used in previous discourse. Experiment 2 aims to cast light on these two alternative possibilities.

5.1. Methods

5.1.1. Design

Two factors were crossed in a 2x2 design. Each trial consisted of a dialogue in which one of the speakers would ask three question, the first of which was always Polar Question. Factor 1 manipulated the type of second question, with NAQ and CAQ as levels; Factor 2 manipulated the type of the third question, with two levels: a question identical to the first PQ (i.e., “match”, abbreviated “M”); and a question different from the first PQ (i.e., “non-match”, abbreviated “NM”). Specifically, we ran two different sub-experiments, which were identical, except for the way in which the non-matching question was constructed. In Expt2A the non-matching question was a PQ asked with emphatic tone (i.e., all caps); in Expt 2B the non-matching question was a Wh-Question. The item below illustrates the whole paradigm across the two sub-experiments. Moreover, in each sub-experiment we had a control sequence with a Wh-Question as the first question, a PQ as the second, and a NAQ as the third question. This sequence was predicted to be felicitous (see Biezma 2009).

(13)  

Expt2A  
Herb and Kelly are about to play chess. There are only two possible colors: black or white. Herb: “I’m so excited!”  
Kelly: “Do you want black?”  
Herb: “Well, if I can’t wait to play”  

Q1: PQ
5.1.2. Procedure and Statistical analysis

Each subject saw 12 experimental items, 3 for each condition, plus 10 control items. The conditions were crossed in a Latin Square Design. 48 native speakers of English were recruited in each sub-experiment via Mechanical Turk and paid $1.50 for participation. At the end of each trial, participants were asked to answer the following question with a value between 1 and 7: "How natural does the last question of the conversation sound in light of the goal of the speaker? “1” indicated a completely unnatural question; “7” indicated a perfectly natural question. All items were presented in written form on a screen. As in the first experiment, we ran separate mixed-effects models on the ratings of questions, with Q2 type and Match as the main effects, and random slopes for Subjects and Items. Again, the models were ran with the lmerTest package. To better understand the effects, we then followed up with posthoc comparisons, performing t-tests with a Bonferroni correction for multiple comparisons.

5.2. Results

The results for Expt2A and Expt2B are plotted in Figure 2 and 3 below.
As predicted, the control condition turned out to be felicitous in both studies, and was therefore removed from the analysis. Concerning the test conditions, we entered NAQs and Match as reference levels. The models showed a main effect of Match in both experiments (Expt 2A, Match: $\beta=.90$, SE= 0.23, $p < .001$; Expt 2B, Match: $\beta=1.20$, SE= 0.13, $p < .001$); no effect of Q2 Type in either experiment (Expt 2A, Q2 Type: $\beta=-.15$, SE= 0.09, $p = .09$; Expt 2B, Q2 Type: $\beta=-.12$ SE= 0.16, $p = .33$), and no interaction effect between Q2 Type and Match (Expt 2A, Q2 Type*Match: $\beta=.22$, SE= 0.13, $p=.09$; Expt 2B, Q2 Type*Match: $\beta=-.30$ SE= 0.12, $p =.12$). In particular, within each type of Q2, the last question was rated as more felicitous when it did not match the PQ asked in the beginning of the conversation than when it did (Expt 2A, Q2-NAQ: $p < .001$; Expt 2A, Q2-CAQ: $p < .001$; Expt 2B, Q2-NAQ: $p < .01$; Expt 2B, Q2-CAQ: $p < .001$). In addition, in both experiments, no difference between CAQ and NAQ was found within Match. (Expt 2A, Match: $p >.5$; Expt 2A, Non-Match: $p >.5$ ;Expt 2B, Match: $p >.5$; Expt 2B, Non-Match: $p >.5$).

5.3. Discussion

These findings suggest that what determines the status of the final question in a conversation is not whether the preceding move is a NAQ or a CAQ, but rather whether the same question had been asked before. We take this results as evidence supporting Hypothesis 3: the observed necessarily discourse-final status of NAQs is not driven by their features per se, but rather by the fact that follow-up PQs are not felicitous when they had already been used and did not accomplish the intended goal. If the follow-up question differs from the first question, either in terms of syntactic structure of intonation, neither NAQs nor CAQs need to be discourse final. The emerging picture is one in which also Part 2 of Cornering can be explained by appealing to general pragmatic principles that apply beyond the domain of alternative questions.
6. General Discussion

We now turn to discuss in greater detail how these principles can be modeled for both components of the effect.

6.1. Explaining Part 1: Information Structure and Focus

We showed that NAQs’ ban in discourse-initial position is not featured by CAQs, ruling out the possibility that this restriction be featured by the logical exhaustivity/exclusivity of the alternatives. Furthermore, based on the results of Experiment 2, we suggested that this restriction is likely not driven by bundling either; since bundling does not make the right predictions concerning Part 2 of cornering, requiring an independent explanation for it, it might be more appropriate to also explain Part 1 independently. In this regard, we observed earlier that NAQs are not the only type of question that is infelicitous discourse-initially; more generally, this restriction applies to all questions that have focus on the polarity (in (16)), whereas it doesn’t apply to questions that have focus on the property, including CAQs (in (17)).

(16) Speaker A: Jane had a baby!
   a. Speaker B: #IS$_F$ it a boy?
   b. Speaker B: Is it a boy$_F$ or not$_F$?

(17) Speaker A: Jane had a baby!
   a. Speaker B: Is it a BOY$_F$?
   b. Speaker B: Is it a boy$_F$ or a girl$_F$?
As for the reason that underlies this restriction, we follow Schwarzschild (1999) in proposing that to license narrow focus on BOY in (17) above, the proposition that there exists a property such that the baby has this property has to be given. To license narrow focus on the polarity, as in (16), the following proposition needs to be given: there is a polarity function (ranging over \{\lambda p.p, \lambda p.\neg p\}) that, applied to the proposition “that the baby is a boy”, yields a true proposition. The two propositions are reported below:

(18)  
   a. \exists X_{<e,\text{st}>}[\text{the baby is } X \text{ at } w] 
   b. \lambda w. \exists X_{<\text{st},\text{st}>}[X(\lambda w'.\text{the baby is a boy at } w')(w)]

We suggest that these two propositions differ with respect to the ease with which listeners can accommodate them. In particular, accommodating the existence of a property is a relatively routine task, which does not undermine the felicity of the question that presupposes this proposition; by contrast, accommodating the presence of a polarity function is a much harder task, which goes through smoothly only if the issue \{p, \neg p\} has already been risen. While providing a detailed account of reason explaining this difference goes beyond the scope of the current paper, we observe that this constraint on polarity focus in discourse-initial position bears intuitive resemblance to a general Economy Principle that penalizes the use of meta-conversational moves out of the blue, when the issue has not been raised explicitly in the previous discourse (Romero and Han 2004).

(19)  
   Principle of Economy: Do not use a meta-conversational move unless necessary (to resolve epistemic conflict or to ensure Quality).

For example, the authors suggest that using an epistemic adverb like really to express commitment to adding a proposition to the Common Ground expresses a contribution that is already encoded in any assertion, hence potentially trivial; this contribution is felicitous only as long as the previous discourse explicitly called for the use of these expressions, for example raising the issue around p.

(20)  
   a. #I really am going to eat outside tonight. Out of the blue 
   b. A: I don’t believe you are going out tonight! 
      B: Yes! I really am going to eat outside tonight! Issue already risen

While Polarity functions do not qualify as meta-conversational moves in the sense of really, they similarly run the risk of providing a redundant contribution. Since propositions inherently have a polarity value in their logical form, and since the alternative set of this value is trivially closed, focusing on such a value amounts to providing a redundant contribution, unless the development of the previous discourse calls for emphasis on it—for example, if the issue around the polarity of the proposition has already been raised. The same does not hold for property focus. While it is arguably true that “boy” only has another element in its alternative set (i.e., “girl”), the speaker could have chosen among many other types of properties to fill that slot; as such, focusing on the property is felicitous also in situations in which the issue had not been raised in previous discourse.
6.2. Explaining Part 2: *Repeat

Concerning NAQs’ observed inability to license follow up questions, we suggested that it can be seen as an artifact of a general pragmatic principle that penalizes the felicity of inquisitive strategies that were previously unsuccessful in discourse; this naturally applies regardless of whether such strategies were preceded by a NAQ or a CAQ. Supporting this claim is the observation that multiple strategies are available for the speaker to follow up to a NAQ/CAQ with another question, such as placing special emphasis on the question, or switching to a different question form. We labeled this principle *Repeat.

(21) *Repeat: When pursuing an issue, avoid re-using a strategy that previously didn’t help solve the issue.

The upshot is that Part 2 of cornering is linked to the optimal strategies that the speaker should pursue to solve the QUD. As such, the infelicity of follow up PQs observed in the previous literature emerges as a side effect of NAQs’ licensing conditions: since NAQs always need to come after a move that raised the issue—which in many cases happens to be a PQ, as in Experiment 1—a follow up move of the identical type—e.g., another PQ—will automatically cause a violation of *Repeat, leading to infelicity. Once again, we believe that this principle applies beyond the domain of alternative questions. While more research would be needed to explore its implications in other realms, we observe that it also appears to be at work with imperatives as well. In the following context, for example, it seems natural for the speaker to resort to a different strategy to express a command, once the previous attempts failed. To keep using the same command, by contrast, appears to be an example of irrational linguistic behavior.

(22) A: Stop playing!
B: [Keeps playing]
A: Hey, can you stop playing?
B: [Keeps playing]

a. A: # Stop playing!
b. A': I told you to stop playing

7. Conclusion

We have provided evidence supporting the following hypothesis: both effects of cornering are not linked to the distinctive properties of negative alternative questions, but rather stem from general pragmatic principles that govern communication across constructions. As we leave a more detailed modeling of how these principles interact with the compositional properties of different question types, we hope that these results will contribute to fueling further inquiry aimed at understanding how linguistic constructions with seemingly similar logical properties differentially shape the discourse space in interaction.
References


Abstract. In recent years, experimental research has demonstrated great variability in the rates of scalar inferences across different triggering expressions (Doran et al. 2009, 2012, van Tiel et al. 2016). These studies have been taken as evidence against the so-called uniformity assumption, which posits that scalar implicature is triggered by a single mechanism and that the behaviour of one scale should generalize to the whole family of scales. In the following, we present an experimental study that tests negative strengthening for a variety of strong scalar terms, following up on van Tiel et al. (2016). For example, we tested whether the statement John is not brilliant is strengthened to mean that John is not intelligent (see especially Horn 1989). We show that endorsement rates of the scalar implicature (e.g., John is intelligent but not brilliant) are anti-correlated with endorsements of negative strengthening. Further, we demonstrate that a modified version of the uniformity hypothesis taking into account negative strengthening is consistent with van Tiel et al.’s data. Therefore, variation across scales may be more systematic than suggested by the van Tiel et al. study.

Keywords: Scalar diversity, scalar implicature, manner implicature, negative strengthening, inferencing task.

1. Introduction

For more than a decade, scalar implicatures have been a core topic of experimental pragmatics. However, theoretical and experimental research has concentrated on a few scales only, most notably the scales ⟨all, some⟩ and ⟨and, or⟩. In van Tiel et al. (2016) the authors provide an overview of 29 experimental studies from 2001 to 2014. Of them, only two studies consider scales other than ⟨all, some⟩ and ⟨and, or⟩. They speculate that the underlying reason for this bias is the belief that these scales are somehow representative for scales in general, such that findings on them can be generalized to all scales. This is the so-called uniformity hypothesis. This hypothesis has received some interest in recent years. The experimental studies in Doran et al. (2009, 2012) and van Tiel et al. (2016) addressed it in a special form: they tested the hypothesis that all scales show the same capacity for generating scalar implicature. This means, in this special form the hypothesis states that there is a constant percentage s such that for all scales i about s% of the subjects will draw an implicature for the weak scalar alternative. The most thorough and systematic study on this hypothesis was presented by van Tiel et al. (2016). They tested 43 scales, among them 32 scales with adjectives, 6 with main verbs, 2 with auxiliary verbs, 2 with quantifiers, and 1 with adverbs. In their first experiment, they presented 25 subjects with questions of the form: John says: She is intelligent. Would you conclude from

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1We would like to thank Jacopo Romoli, Alexandre Cremers, Richard Breheny, Stephanie Solt, Bob van Tiel and the audience of Sinn und Bedeutung and the annual Xprag.de meeting for helpful comments on this work. This research was supported by the Bundesministerium für Bildung und Forschung (BMBF) (Grant Nr. 01UG1411), and the Deutsche Forschungsgemeinschaft (DFG) (Grant Nr. BE 4348/4-1). Author names appear in alphabetical order. AB and NG contributed equally to writing this paper and CBF implemented the experiment.

this that, according to John, she is not brilliant? Subjects then had to choose between the answers yes and no. Here, the relevant scale is \(\langle\text{brilliant, intelligent}\rangle\). If subjects answer yes, then they must have drawn the implicature intelligent \(\rightarrow\) not brilliant. The results of the study revealed that scales show considerable variance in their ability for generating scalar implicatures. In a post-analysis of their data, van Tiel et al. (2016) found that boundedness of a scale and perceived distance between the strength of alternatives predicts implicature rates. That is, participants were more likely to derive a scalar implicature if the stronger scale-mate denotes an endpoint on the underlying measurement scale (see especially Kennedy and McNally 2005 for a scale typology) and the greater the difference in strength was rated.

Van Tiel and colleagues also considered a number of other parameters as predictors of implicature (such the stronger term’s cloze probability, relative frequency, latent semantic value, and grammatical category) but none of these parameters had an effect on implicature rates. Further, they briefly dismissed negative strengthening as a possible confounding parameter (see the discussion on page 141 in van Tiel et al. 2016).

Here, we present the results of a study based on van Tiel et al. (2016) which shows that negative strengthening is (anti-)correlated with scalar implicatures and that a modified version of the uniformity hypothesis, postulating a constant ratio between scalar implicature and negative strengthening, can be maintained. At the same time, we provide evidence that different scale types behave differently with respect to the modified uniformity hypothesis. In conclusion, our data motivate further research into the impact of scale structure on implicature derivation.

2. Negative strengthening

Negative strengthening is the phenomenon whereby the negation of the stronger scalar alternative is pragmatically strengthened to an interpretation that also negates the weaker alternative (Horn 1989, Levinson 2000, Blutner 2004, Krifka 2007). In (1) this is demonstrated for the scale \(\langle\text{happy, content}\rangle\).

\[
\text{happy} \quad \text{\textasteriskcentered content} \quad \text{not happy} \quad \text{unhappy}
\]

The second line shows the semantic extension of the adjective content and its negation, the third line the effect of scalar implicature and negative strengthening: the extension of content is shortened to *content (scalar implicature SI), and that of not happy is strengthened such that it covers the area between content and unhappy (negative strengthening NegS). Negative strengthening is variously explained as R-implicature (Horn 1989), I–implicature (Levinson 2000), or blocking phenomenon (Blutner 2004, Krifka 2007). All authors agree that it arises differently from scalar implicatures, which are a special Q–implicature.

To see the relevance of negative strengthening for the experimental set up of van Tiel et al. (2016), let us consider the following item:
If a subject interprets content and not happy semantically, then s/he has to answer with no since the statement she is content is semantically consistent with her being not happy. If the subject narrows the meaning of content based on scalar implicature, the subject should answer yes. This is how the experiment intended to measure the rate of scalar implicature. However, if participants negatively strengthen the conclusion sentence She is not happy to not content, this interpretation is incompatible with the semantics and the scalar implicature of content. Hence, negative strengthening leads to a no–answer, whatever the subject’s interpretation of content is. The different possibilities of reading content and not happy and the expected yes and no–answers are shown in (3).

<table>
<thead>
<tr>
<th>content</th>
<th>not happy</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>semantic</td>
<td>semantic</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>semantic</td>
<td>NegS</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td>semantic</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>SI</td>
<td>NegS</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>

Hence, a no–answer may be based on a semantic interpretation of negative strengthening. For this reason, the lack of scalar implicature may be masked by the effect of negative strengthening. Let us now consider what this means for the uniformity hypothesis. As we may recall, van Tiel et al. addressed the uniformity hypothesis in a special form, namely that for all scales i the proportion of observed yes–answers so(i) is equal to a fixed probability s. In this form, the uniformity hypothesis is clearly refuted by the experimental studies of Doran et al. (2009, 2012) and van Tiel et al. (2016). However, the formula so(i) = s assumes that negative strengthening has no influence on the observed yes–answers. Let us assume that we can observe negative strengthening with probability no(i) for scale i. Now consider (3). The simplest hypothesis about the relation between negative strengthening and scalar implicature is that negative strengthening of not happy occurs independently of drawing the scalar implicature for content. A yes–answer is given if the scalar implicature is drawn (probability s according to the uniformity hypothesis) and no negative strengthening occurs (probability 1 – no). Hence, the observed proportion of yes–answers so should equal the product s × (1 – no). This leads to the modified uniformity hypothesis that the observed scalar implicature for scale i equals the product of a constant s and the observed probability of no negative strengthening, as formula:

(4) so(i) = s × (1 − no(i)).

A peculiarity of the uniformity hypothesis is that, to our knowledge, it is a hypothesis that
no-one has ever defended. Even though its prior plausibility is low, it seems interesting to defend it for purely methodological reasons. Ultimately, we hope to gain insight into which sub–classes of scales show a uniform behaviour with respect to scalar implicature and negative strengthening.

In order to evaluate the modified uniformity hypothesis, we need an estimate of the proportion of negative strengthening \( n_o(i) \). We need to know how likely it is that subjects understand, for example, not happy as implying not content. We, therefore, ran an experiment with exactly the same items and fillers as (van Tiel et al. 2016: Exp. 1), but modified the questions. For example, for the \( \langle \text{happy}, \text{content} \rangle \) scale, we asked subjects John says: He is not happy. Would you conclude from this that, according to John, he is not content? If the answer is yes, this indicates that subjects negatively strengthened not happy to not content. We will see that the observed rates of yes answers shows similar variability between scales as the rates of yes answers in the original scalar implicature experiment. We show that \( s_o(i) \) and \( n_o(i) \) are anti–correlated, and that the anti–correlation is so strong that the modified uniformity hypothesis cannot be rejected on the basis of van Tiel et al.’s results. However, we also show that we can find sub–classes of scales that behave very differently with respect to the uniformity hypothesis, so that the paper ends with an open question: what are the parameters that determine sub–classes of scales that behave uniformly with respect to scalar implicature and negative strengthening?

3. The Experiment

3.1. Methods

3.1.1. Participants

40 participants with US IP addresses were recruited on Amazon’s Mechanical Turk platform. They were further screened for their native language. In total, 40 native English speakers (mean age: 37.02, 20 female, 20 male) took part in the study.

3.2. Materials

Our task and all materials were based on the study by van Tiel et al. (2016). Participants were presented with a scenario involving two characters, Mary and John, who make a series of statements. Their task was to decide whether a strengthened interpretation follows from a given statement. For example, participants saw the statement John is not brilliant and were asked whether they conclude that John is not intelligent. The latter task is a measure of negative strengthening of the stronger scale-mate. Figure 3.2 presents a sample display participants saw.

If participants respond with yes, they have negatively strengthened not brilliant to not intelligent.

In total, each participant saw statements with 43 scales, all of which are provided in Table 3 in the Appendix, in addition to 6 filler sentences. Two versions of the survey with different orders
Mary says:

*He is not brilliant.*

Would you conclude from this that, according to Mary, he is not intelligent?

Yes No

Figure 1: Sample item of the negative strengthening task

were created and administered to 20 participants each.

3.3. Results

In our analysis, we used the average endorsement rates of scalar implicature provided in van Tiel et al. (2016) and the negative strengthening rates obtained from our own experiment.

On average, for all scales, 42.3% of the subjects answered yes in our rating of negative strengthening. Table 3 in the Appendix presents the negative strengthening ratings for all items. Selected results are shown in (5), plotting the ratings in the scalar implicature (SI) task (van Tiel et al. 2016) and the negative strengthening (NegS) ratings next to each other.

(5) Results for selected scales: % of scalar implicature (SI) from van Tiel et al. (2016), % of negative strengthening (NegS) from our study

<table>
<thead>
<tr>
<th>Scale</th>
<th>SI</th>
<th>NegS</th>
</tr>
</thead>
<tbody>
<tr>
<td>⟨free, cheap⟩</td>
<td>100%</td>
<td>28%</td>
</tr>
<tr>
<td>⟨all, some⟩</td>
<td>96%</td>
<td>42%</td>
</tr>
<tr>
<td>⟨love, like⟩</td>
<td>50%</td>
<td>43%</td>
</tr>
<tr>
<td>⟨finish, start⟩</td>
<td>21%</td>
<td>14%</td>
</tr>
<tr>
<td>⟨exhausted, tired⟩</td>
<td>4%</td>
<td>69%</td>
</tr>
<tr>
<td>⟨happy, content⟩</td>
<td>4%</td>
<td>92%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Scale</th>
<th>SI</th>
<th>NegS</th>
</tr>
</thead>
<tbody>
<tr>
<td>⟨impossible, difficult⟩</td>
<td>79%</td>
<td>25%</td>
</tr>
<tr>
<td>⟨none, few⟩</td>
<td>75%</td>
<td>31%</td>
</tr>
<tr>
<td>⟨unsolvable, hard⟩</td>
<td>71%</td>
<td>43%</td>
</tr>
<tr>
<td>⟨unavailable, scarce⟩</td>
<td>62%</td>
<td>58%</td>
</tr>
<tr>
<td>⟨unforgettable, memorable⟩</td>
<td>50%</td>
<td>56%</td>
</tr>
</tbody>
</table>

Overall, we observe a correlation between $s_0(i)$, the observed % of SIs for scale $i$, and $1 - n_0(i)$, with $n_0(i)$ the % of NegS for $i$ (Spearman’s rank correlation: 0.463, $p < 0.002$). That is, participants are less likely to endorse a scalar implicature if they apply negative strengthening to the stronger scale-mate. Hence, the lack of scalar implicature can, in part, be explained by the presence of negative strengthening.

We also ran a linear regression model for the negative strengthening ratings involving boundedness, semantic distance, grammatical category, frequency, cloze probability, and latent semantic values (using the values obtained in the van Tiel et al. study) as predictors of variability across

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2We based the correlational analysis on the complement rate of the negative strengthening task $(1 - n_0(i))$, which will be explained in detail in Section 4.
scales. The results of the model are displayed in Table 1. The analysis showed that participants were more likely to apply negative strengthening if the weaker and stronger scale-mate had a strong association strength as indexed by the measure obtained in van Tiel et al.’s cloze task. Further, semantic distance (the perceived difference in strength between the statement involving the weaker and the one with the stronger term) had a negative effect on ratings. That is, the occurrence of negative strengthening was less likely the closer the semantic distance between the stronger and weaker term. In our experiment, the upper boundedness of scales did not have a significant effect on negative strengthening rates.

<table>
<thead>
<tr>
<th></th>
<th>Estimate</th>
<th>SD</th>
<th>t-value</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Intercept)</td>
<td>1.01843</td>
<td>0.23029</td>
<td>4.422</td>
<td>0.000</td>
</tr>
<tr>
<td>Cloze probability</td>
<td>0.45191</td>
<td>0.11194</td>
<td>4.037</td>
<td>0.00028</td>
</tr>
<tr>
<td>Category</td>
<td>0.08695</td>
<td>0.104</td>
<td>0.836</td>
<td>0.4088</td>
</tr>
<tr>
<td>Frequency</td>
<td>0.04462</td>
<td>0.03086</td>
<td>1.446</td>
<td>0.15706</td>
</tr>
<tr>
<td>LSA</td>
<td>-0.11782</td>
<td>0.17463</td>
<td>-0.675</td>
<td>0.50428</td>
</tr>
<tr>
<td>Distance</td>
<td>-0.13364</td>
<td>0.04042</td>
<td>-3.307</td>
<td>0.00219</td>
</tr>
<tr>
<td>Boundedness</td>
<td>-0.09099</td>
<td>0.05843</td>
<td>-1.557</td>
<td>0.12841</td>
</tr>
</tbody>
</table>

3.4. Discussion

The current study showed that negated strong scalar terms give rise to varying degrees of inferences negating their weaker scale-mates. Such negative strengthening is traditionally thought of as a manner implicature, arising from a different principle than scalar implicatures (Horn 1989, Levinson 2000). In our analysis, we showed that participants’ endorsement of scalar implicatures was anti-correlated with the degree of negative strengthening of the stronger scale-mate.

Van Tiel et al. (2016) discussed negative strengthening as a possible confound in their results (p. 144) but dismissed this possibility with the argument that their data show that scales containing a negative element generate high rates of implicature, although these scales are known for showing a robust tendency towards negative strengthening (Horn 1989, Krifka 2007). Table 5 on the right side shows the results for negative scales. Contrary to expectations, negative scales in our study were not particularly strong triggers of negative strengthening.

It should be noted that the numerical correlation we observed was not perfect. Hence, it is not the case that negative strengthening takes away all the variance observed in the scalar implicature task. Further, previous studies by Doran et al. (2009, 2012) demonstrated a similar amount of variation across scales as the van Tiel et al. study and their paradigm did not involve a negation as part of the instructions. In that study, participants were presented with a dialogue and a fact. Their task was to judge whether the answer was true or false given the fact. For example, Sam said *Gus ate most of the birthday cake* and the fact was that Gus had eaten the entire cake. In this verification task, the rates of scalar inferences were comparable to the ones by van Tiel et al. (2016) and there was considerable variation across adjectival scales and quantifiers.
It remains to be established whether the correlation between scalar implicature and negative strengthening we observed here is an artefact of the inferencing task, that is, because the negation of the stronger scale-mate was mentioned in the conclusion sentence. Rather than assuming that the interaction between scalar implicature and negative strengthening is merely a task effect, we might expect this interaction to be of broader importance. While the two kinds of implicature arise from different conversational principles, Levinson (2000) and Horn (1989) assume that the Q and R principle govern each other in conversation (see also Blutner 2004, Krifka 2007). Therefore, whether or not hearers derive a scalar implicature may also be influenced by the availability of other types of inferences.

4. The uniformity hypothesis: A modified version

The studies of Doran et al. (2009, 2012) and van Tiel et al. (2016) convincingly show that the uniformity hypothesis \( s_0(i) = s \) for a constant \( s \) is false. However, the question arises whether the assumption of a uniform constant can be maintained if the effect of negative strengthening is factored in. Given the anti-correlation between \( s_0(i) \) and \( 1 - n_0(i) \), the simplest reformulation of the uniformity hypothesis (UH) is to postulate a constant ratio between these values, i.e. that there is a constant \( s \) such that for all scales \( i \) \( s_0(i)/(1 - n_0(i)) = s \), or, equivalently, that \( s_0(i) = s - s n_0(i) \), see (4). The constant \( s \) can be fitted to the data. Using the data from van Tiel et al.’s scalar implicature task and our negative strengthening task, an optimal value of \( s = 0.77 \) was found.\(^3\) Figure 2 shows \( s_0(i) \) over \( n_0(i) \) for all scales \( i \). A simple linear regression was calculated to predict \( s_0(i) \) (yes-answers in van Tiel et al.’s SI task) based on \( n_0(i) \) (yes-answers in our NegS task). A significant regression equation was found \((F(1,41) = 7.80, p < .01)\), with an adjusted \( R^2 = 0.14 \). The proportion \( s_0(i) \) of yes answers in the SI task is equal to \( 0.68 - 0.55 n_0(i) \). The regression line (blue) is also shown in Figure 2, together with its 95% confidence interval. The green line is the regression line predicted by the modified uniformity hypothesis with \( s = 0.77 \), i.e. \( s_0(i) = 0.77 - 0.77 n_0(i) \). As can be seen from Table 2, the line predicted by the modified uniformity hypothesis lies within the 95% confidence interval of the calculated linear regression line. Hence, the predicted regression line does not significantly differ from the calculated one, and can, therefore, not be rejected. In this sense, the modified uniformity hypothesis is consistent with the results found by van Tiel et al.

Clearly, to defend a hypothesis by showing that it cannot be refuted by some statistics is not an argument to accept the hypothesis. However, the modified uniformity hypothesis is nevertheless interesting because it establishes a numeric relation between a scale’s propensity to trigger two different types of implicature, in this case a quantity implicature (SI) and an I/M-implicature (NegS). In the following we will see that the modified uniformity hypothesis can be a useful tool for distinguishing different classes of scales that support or do not support it. As previously noted, the presence of an upper bound and semantic distance between scalar alternatives are significant predictors of yes answers in van Tiel et al.’s SI task. In Section 3.3, we have seen that semantic distance and cloze probability are significant predictors of negative strengthening. We

\(^3\)We used the form of the modified uniformity hypothesis as stated in (4) and chose the \( s \) that minimizes \( \langle(1 - n_0(i))s - s_0(i)\rangle \). Choosing the mean of ratios \( s_0(i)/(1 - n_0(i)) \) leads to a slightly higher value for \( s \) but doesn’t change the conclusions. The reason for not choosing ratios is that some of them are greater than 1. As \( s \) is supposed to represent the proportion of subjects answering yes in the van Tiel et al. task, values higher than 1 are empirically meaningless.
now introduce a distinction of scale types that is primarily motivated by research on negative strengthening (Blutner 2004, Krifka 2007), and show that the new scale types behave very differently with respect to the modified uniformity hypothesis.

The distinction that we introduce is that between L-scales and M-scales. A prototypical L-scale would be the \langle all, some \rangle scale. If we consider the underlying measurement scale that reaches from proportions of 0% to 100%, then the Horn scale \langle all, some \rangle starts from the lower end of the measurement scale. This means that the weak scale mate some covers the whole measurement scale except for 0%, that is the lower end. The contrary none of all is also the contradictory of some. In contrast, M-scales are scales that start somewhere in the middle of the underlying measurement scale. Examples are the \langle happy, content \rangle scale, and the \langle hot, warm \rangle scale. In both cases, there is a gap between the weaker scale mate and the contrary of the stronger scale mate. In other words, the contradictory of the weaker scale mate is not the contrary of the stronger one. For \langle happy, content \rangle this means that there is a gap between the meaning of content and the contrary of happy, namely unhappy, see (6) and (1). Likewise, for \langle hot, warm \rangle there is a gap between the meaning of warm and the contrary of hot.

\begin{equation}
\begin{array}{c}
\text{happy} \quad \ast \quad \text{content} \quad \ast \quad \text{gap} \quad \ast \quad \text{unhappy}
\end{array}
\end{equation}

In Blutner (2004) and Krifka (2007), negative strengthening is explained as a blocking phenomenon. In their models, marked expressions narrow their meanings as they are blocked from referring to certain meanings \(m\) by the existence of less marked expressions that are better candidates for referring to \(m\). This means that, for example, not happy is blocked from referring to states covered by content, as content is less marked. Likewise, not happy is blocked from referring to the extreme end of the unhappiness side because of the less marked expression unhappy. Hence, the meaning of not happy is narrowed down to the gap between content and unhappy. If this explanation for negative strengthening is correct, then L-scales should not give rise to negative strengthening as there is no gap which can be filled by the negation of the stronger scale mate. The observed rates of yes-answers in our NegS task would then have to be explained as random noise. This also means that we should expect M-scales to better conform to the modified uniformity hypothesis than L-scales. In the following, we test this prediction.
In Table 3 in the Appendix we provide an annotation of the different scale types. There are 32 M-scales among the 43 scales considered by van Tiel and colleagues. A simple linear regression was calculated to predict \( s_0(i) \) (yes-answers in van Tiel et al.’s SI task) based on \( n_0(i) \) (yes-answers in NegS task) for M-scales \( i \). A significant regression equation was found \( (F(1, 30) = 28.27, p < .0001) \), with an adjusted \( R^2 = 0.47 \). The proportion \( s_0(i) \) of yes answers in the SI task is equal to \( 0.92 - 1.05 n_0(i) \). The regression line (blue) is shown in Table 3, together with its 95% confidence interval. The green line is the regression line predicted by the modified uniformity hypothesis with \( s = 0.80 \), i.e. \( s_0(i) = 0.80 - 0.80 n_0(i) \). As can be seen from Figure 3, the line predicted by the modified uniformity hypothesis lies within the 95% confidence band of the calculated linear regression line.

Further, the statistical parameters show that the correlation between \( s_0(i) \) and \( 1 - n_0(i) \) is much stronger in the case of M-scales than for all scales taken together.

There are 11 L-scales among the 43 scales considered by van Tiel et al. A simple linear regression was calculated to predict \( s_0(i) \) (yes-answers in van Tiel et al.’s SI task) based on \( n_0(i) \) (yes-answers in NegS task) for M-scales \( i \). A marginally significant regression equation was found \( (F(1, 9) = 5.02, p = .052) \), with an adjusted \( R^2 = 0.29 \). The proportion \( s_0(i) \) of yes answers in the SI task is equal to \( 0.40 + 0.67 n_0(i) \). The regression line (blue) is shown in Table 2, together with its 95% confidence interval. The green line is the regression line predicted by the modified uniformity hypothesis with \( s = 0.73 \), i.e. \( s_0(i) = 0.73 - 0.73 n_0(i) \). As can be seen from Figure 2, the line predicted by the modified uniformity hypothesis does not lie within the 95% confidence interval of the calculated linear regression line; rather, it follows a completely different pattern.

As we can see, there is no significant positive correlation between \( s_0(i) \) and \( 1 - n_0(i) \); to the contrary, there is a marginal negative correlation between them for L-scales. There is also a considerable visual difference between the calculated regression line and the predicted regression line. We conclude that the modified uniformity hypothesis does not explain the pattern L-scales adhere to.

As we mentioned before, the uniformity hypothesis is peculiar in that it has, to our knowledge, not been defended by anyone. It was merely put forward as a likely explanation for why
previous experimental research concentrated on a few scales, most notably the \( \langle all, some \rangle \)–scale. The distinction between L– and M–scales may provide another reason for concentrating on this scale. As it is an L–scale, it should be affected by negative strengthening to a lower extent.\(^4\) It may, therefore, be better suited to test scalar implicature.

Our analysis of L-scales and M-scales is intended as a demonstration of the usefulness of the modified uniformity hypothesis as a tool for establishing interesting distinctions among scale types. However, one should not over-estimate what we have achieved here. The same contrast between L-scales and M-scales that we find in Figures 2 and 3 exists between bounded and unbounded scales, as well as between non-adjectival and adjectival scales. This means that M-scales, unbounded scales, and adjectival scales conform better to the modified uniformity hypothesis than all scales taken together, and for L-scales, bounded scales, and non–adjectival scales, it has to be rejected. Even this result should be taken with caution. There is a considerable overlap between M-scales, unbounded scales and adjectival scales in the sample collected by van Tiel et al. such that it remains an open issue which of them causes scales to conform or not to conform to the modified uniformity hypothesis.

The issue about the predictors of uniformity carries over to the issue of predictors of yes–answers in van Tiel et al.’s paradigm. Van Tiel et al. found that boundedness and semantic distance are significant predictors of yes–answers. Due to the overlap between bounded, non–adjectival, and L-scales, however, the significant correlation between boundedness and yes–answers vanishes once the effect of being an M–scale or being an adjectival scale is taken into account.

In a similar vein, McNally (2017) argues that the methods used by van Tiel et al. were too crude to (i) detect certain implicatures and (ii) detect effects of the parameters explaining variation across scales tested. Essentially, the problem McNally discusses is that adjectives are polysemous, and in the absence of a context participants may construct a meaning on the fly and not think of the intended pair as scale-mates. This criticism also applies to the current study and it stresses the need to present test sentences within a conversational context. Our analysis showed that it is not entirely clear at this point which predictors of variability are crucial in explaining variation across scales.

\(^4\)In fact, it has been argued that negation of the stronger scale-mate leads to scale reversal, i.e. that not all implicates some but not all (see e.g. Levinson 2000: p. 80ff, with references to previous literature).
diversity. Hence, our investigation motivates further research into the impact of scale structure on implicature derivation. Comparing how a large variety of scales behave within an enriched communicative context has to be left to future research. One experimental paradigm which might be useful for this endeavour is the action-based task by Gotzner and Benz (2018), and its interactive version (Benz et al. 2018), which has been implemented for the quantifier some and the determiner or (Benz and Gotzner 2017). The advantage of this paradigm is that utterances are embedded in a communicative situation and candidate readings are made relevant. The current study indicates that for future experiments on scalar diversity, a balanced set of items varying in scale structure is needed.

5. Conclusion

In the current study, we demonstrated an interaction between two kinds of implicature: scalar implicatures which are Q–based, and negative strengthening, which is I– or M–based. In particular, there was an anti-correlation between the endorsement rates of scalar implicatures and the degree of negative strengthening of the stronger scale-mate. We showed that a modified version of the uniformity hypothesis is consistent with the data presented by van Tiel et al.’s study. We also provided evidence that the correlation between scalar implicature and negative strengthening may be sensitive to general scale structure. This shows that a more fine-grained typology of scales can be motivated by numerical analysis. However, the most interesting outcome of our study is the questions that it raises. What are the true predictors of scalar implicature and negative strengthening for different types of scales? Can a classification based on structural properties of scales be established such that all members of a class have the same propensity for triggering different types of implicature? Which other types of conversational implicature are sensitive to scale structure, besides scalar implicature and negative strengthening? Can conversational context make scales behave uniformly? For example, do all scales reliably trigger scalar implicatures if the meaning differences are made contextually relevant? Is there an experimental paradigm which allows the measuring of scalar implicature without negative strengthening or typicality effects as confounding factors? In conclusion, the present paper highlights the importance of further research into the impact of scale structure on scalar implicature.

References


6. Appendix
Table 3: Weak and strong scale-mates, their negative strengthening rates obtained in our experiment, scalar implicature rate from van Tiel et al. (2016, reprinted with permission from Oxford University Press), scale type, upper bound (B = bounded, NB = non-bounded) and category (open vs. closed class) and part of speech (Adj = adjective, V = verb, Det = determiner, Adv = adverb)

<table>
<thead>
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Embedded implicature in a new interactive paradigm
Anton BENZ — Leibniz Centre General Linguistics
Nicole GOTZNER — Leibniz Centre General Linguistics
Lisa RAITHEL — Potsdam University

Abstract. Previous research on scalar implicature has primarily relied on metalinguistic judgment tasks and found varying rates of such inferences depending on the nature of the task and contextual manipulations. This paper introduces a novel interactive paradigm involving both a production and a comprehension component, thereby fixing a precise conversational context. The main research question is what is reliably communicated by *some* in this communicative setting, when the quantifier occurs in unembedded positions as well as embedded positions. Our new paradigm involves an action-based task from which participants’ interpretation of utterances can be inferred. It incorporates a game-theoretic design, including a precise model to predict participants’ behaviour in the experimental context. Our study shows that embedded and unembedded implicatures are reliably communicated by *some*. We propose two cognitive principles which describe what can be left unsaid. In our experimental context, a production strategy based on these principles is more efficient (with equal communicative success and shorter utterances) than a strategy based on literal descriptions.

Keywords: scalar implicature, embedded implicature, experimental pragmatics, game-theoretic pragmatics.

1. Introduction

In the current paper, we introduce a new experimental paradigm to test implicatures in an interactive scenario. We provide comprehension data on a variety of utterance combinations involving one or multiple scalar terms.

Implicatures of complex sentences have been a controversial topic of discussion. A variety of theoretical approaches have been developed (e.g. Chierchia et al. 2012, Sauerland 2004, Franke 2009, Benz 2012, Pavan 2013, Potts et al. 2016), and conflicting experimental evidence has been produced (e.g. Geurts and Pouscoulous 2009, Chemla and Spector 2011, van Tiel 2014). The relevant complex sentences are those in which an implicature trigger like ‘*some*’ is embedded under a quantifier, which may itself be an implicature trigger. For example, the sentence (A-E) ‘Each girl found some of her marbles’ potentially gives rise to the inference that each girl found some but not all of her marbles. In the course of this debate, a view took hold according to which sentence meaning is highly ambiguous, and different implicatures are just different readings that language speakers may entertain (in particular Chierchia et al. 2012). In this paper, we instead are guided by the standard neo–Gricean view (Levinson 1983) that considers implicature as part of communicated meaning. Therefore, our main research question

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1 We would like to thank Danny Fox, Uli Sauerland, Jack Tomlinson, Bob van Tiel and the audience of Sinn und Bedeutung and the XPRAG Conference in Cologne for helpful comments on this work. This research was supported by the Bundesministerium für Bildung und Forschung (BMBF) (Grant Nr. 01UG1411), and the Deutsche Forschungsgemeinschaft (DFG) (Grant Nr. BE 4348/4-1). Author names appear in alphabetical order. AB and NG contributed equally to writing this paper and LR programmed the system for the experiments.

What can be reliably communicated by sentences containing embedded or un-embedded ‘some’? In the following, we operationalise this research question and develop a new interactive experimental paradigm that involves the production and interpretation of embedded ‘some’.

We started out with the following basic idea: A speaker who wants to communicate a certain proposition can express all he wants to express literally, or he may take advantage of implicature, and leave certain aspects unsaid. This will lead to a shortening of utterances. Hence, our main research question can be reformulated as follows: To what extent can a description be shortened without jeopardizing communicative success? The shortest descriptions will then reveal all the implicatures that can be communicated reliably. To turn this idea into a testable theory, we formulated two cognitive principles that guide the elimination of linguistic material related to embedded ‘some’: (ENA-Elim) the simplification of ‘some but not all’ to ‘some’, and (N-X-Elim) the elimination of ‘none found X’. For example, together they allow the simplification of literal ‘Some found all, some some but not all, and none none’ to ‘some all and some some’.

With utterances composed of sentences of the form (X-Y) ‘X of the girls found Y of the marbles’ with X and Y chosen from quantifier phrases ‘none’, ‘some’, ‘any’, ‘some but not all’, ‘some and possibly all’, and ‘all’, seven different worlds can be semantically distinguished depending on whether there are some who found none, some who found some but not all, or some who found all. As a next step towards a testable hypothesis, we defined a critical production strategy for the seven possible worlds applying the two elimination rules to a literal production strategy.

The main hypotheses we tested in our experiments were the following: (I) The critical strategy is as successful at communicating the state of the world as the corresponding literal strategy; (II) any further reduction of utterance length leads to a considerable decrease in communicative success. In the following, we present an experimental study that tests the efficiency of the critical strategy for all seven worlds. Specifically, we tested whether this strategy is communicatively successful, and how it compares to strategies pursued by naive participants, in particular whether they produce shorter utterances, and if so, whether these utterances are still successful. Our experiments indicate that the critical strategy is among the shortest strategies with almost maximal communicative success.

This paper is organized as follows. First, we review theoretical and experimental research on embedded implicature. Second, we provide the background assumptions for our new interactive paradigm. Third, we present two experiments implementing the paradigm. Finally, we compare our new experimental paradigm to previously-used paradigms and discuss the implications of the findings for theories of implicature.

2. Embedded implicature: theory and experiments

Consider the following scenario: there are four girls that have to clean up their rooms and find their marbles with which they played before. If one parent says ‘Some of the girls found their marbles’, then the other parent can infer that not all of the girls found them. Grice (1975)
explained this inference from the assumption that the speaker is truthful and follows the so-called maxim of quantity, which requires utterances to be as informative as required. In a situation in which all girls found their marbles, a truthful parent could have said both ‘all found them’ and ‘some found them’. The first alternative is more informative and, presumably, the additional information is also relevant, hence, the maxim of quantity would compel the parent to say ‘all’. As s/he said ‘some’, the probable reason is that not all found their marbles. It follows that some but not all must have found them.

This reasoning was systematised by Horn (1972, 1989), Gazdar (1979), and others. Their model is known as the neo–Gricean model of scalar implicature. In this model, the two alternatives ‘some’ and ‘all’ form a scale, which means that they are equally complex, and that sentences with ‘some’ are logically weaker than the corresponding sentences with ‘all’. If the speaker chooses the weaker alternative, then normally the addressee is entitled to infer that the stronger alternative is false. This inference is called an implicature, and since it is triggered by the scale ⟨all,some⟩, it is called a scalar implicature.

The problem of implicatures of complex sentences can be formulated as follows: How does the neo–Gricean model have to be modified if ‘some’ occurs in the scope of another quantifier, or other logical operator? Two critical examples are shown in (1).

(1)  a) All of the girls found some of their marbles.

        b) Some of the girls found some of their marbles.

In both sentences, ‘some’ occurs in upward entailing contexts. The rule that these sentences implicate the negation of all sentences resulting from a replacement of ‘some’ by ‘all’ predicts that (1a) implicates (2a), and (1b) all three sentences in (2).

(2)  a) It is not the case that all of the girls found all of their marbles.

        b) It is not the case that all of the girls found some of their marbles.

        c) It is not the case that some of the girls found all of their marbles.

Here, the whole sentences resulting from replacing ‘some’ with ‘all’ are negated, therefore these implicatures are called global implicatures. There is also the possibility of applying negation locally. This means that the negation of ‘all’ is embedded where ‘some’ occurs in the sentence. This rule predicts the following additional implicatures:

(3)  a) All of the girls found some but not all of their marbles.

        b) Some of the girls found some but not all of their marbles.

        c) Some but not all of the girls found some of their marbles.

See (Levinson 1983: Ch. 3) and (Levinson 2000: Ch. 2) for a summary.
d) Some but not all of the girls found some but not all of their marbles.

Sentence (3a) is the local implicature of (1a), and (3b), (3c), and (3d) are local implicatures of (1b).³

There exist a variety of theoretical accounts of implicature in complex sentences which make different predictions. In particular, there has been a controversial debate about locally embedded implicatures (see Sauerland 2010, Geurts and van Tiel 2013 for an overview of the debate). Approaches can be divided into structural accounts that predict local implicatures by integrating them into compositional semantics (Chierchia 2004, Fox 2007, Chierchia et al. 2012), or by generalising the neo–Gricean approach so that expected implicature can be derived as global implicature (Sauerland 2004, Geurts 2010). Other approaches derive them from requirements on discourse relations (Asher 2013), or pragmatically from the interaction between speaker and hearer in game–theoretic and probabilistic models (Franke 2009, Benz 2012, Pavan 2013, Potts et al. 2016).

The approaches also make different predictions about the context dependence and strength of implicatures. For example, Chierchia (2004) assumed that the local implicatures predicted by his theory are default inferences, whereas newer grammatical accounts consider them alternative readings which may or may not be preferred (Chierchia et al. 2012). In such an approach, (1b) is considered ambiguous between its standard semantic meaning, and (3b), (3c), and (3d). In probabilistic accounts, there may be a dominant interpretation, but, in general, all semantically possible interpretations receive some positive probability (Potts et al. 2016). Other approaches predict a unique interpretation, which is, however, in some specified manner dependent on context. In the standard neo–Gricean theory, conversational implicatures are part of communicated meaning (Levinson 1983: Ch. 3, p. 131). This suggests that they are communicated as reliably as semantic meaning. Such a strong claim was, however, until now, not supported by the experimental literature. In the case of un–embedded ‘some’, proportions of subjects inferring the implicature can be high but for embedded ‘some’ they tend to be rather low. Reported numbers for embedded scalars range from 0% (Geurts and Pouscoulous 2009) to 40% (Chemla 2009).⁴ In the same study, Geurts and Pouscoulous report values between 34% and 93% for un–embedded ‘some’, depending on the test paradigm. If implicatures are communicated as reliably as literal content, the proportion of subjects inferring implicatures should be close to ceiling. With a few exceptions in the case of un–embedded ‘some’, this has generally not been observed. Hence, experimental evidence seems to lend support to grammatical and probabilistic accounts that are consistent with high degrees of uncertainty in utterance interpretation.

In the following experiment, we show that embedded implicatures can be communicated as reliably as literal meaning. As the experimental literature demonstrates, we can only hope

³ However, (3b)–(3d) are already implied by the global implicatures of (1b) in (2) such that (3a) is the only local implicature that is not implicated globally.

⁴ Other studies report values that lie between these extremes, see (Chemla and Spector 2011, Benz and Gotzner 2014, Potts et al. 2016, Franke et al. 2017). Clifton Jr and Dube (2010) used a picture selection task and reported 71% of subjects arriving at local implicature in one of their experiments (Exp. 1, p. 7). However, their study may be affected by typicality effects as van Tiel (2014) argued.
to show this for certain contexts. So, the question arises, for which contexts can we expect implicature to be inferred reliably?

For Grice (1975), an implicature is an inference towards the speaker’s intended meaning. The inference is based on the assumption that the speaker adheres to the conversational maxims, which include the maxim of quantity, and the over-arching cooperative principle, which states that the speaker contributes to an ‘accepted purpose or direction of the talk exchange’ in which s/he and the hearer are engaged (Grice 1989: p. 26). Grice’s maxim of quantity requires the speaker to provide enough information and not more than this. In sum, an implicature must be the speaker’s intended meaning providing neither more nor less information than is required by a recognisable purpose of the talk exchange. A requirement that is not explicitly listed by Grice is the competence assumption: it must be shared knowledge between speaker and hearer that the speaker is competent enough to contribute the required information. If Grice’s was right about the role of the cooperative principle and speaker’s intentions, then a sentence produced non-conversationally should generate no conversational implicature.

Given this background, we may consider the picture verification task by Geurts and Pouscoulous (2009), which yielded particularly low proportions of subjects answering in accordance with embedded implicature. In this experiment, the test sentence was not produced by a recognisable speaker, it is not an utterance, there is no addressee, there is no recognisable purpose of the talk exchange, and, hence, there is no intended message that could be sought out behind its literal meaning. The situation is detached from purposeful conversation, and, hence, lacks a central precondition in Grice’s theory. To different degrees, all picture verification, graded acceptability and inferencing tasks are affected by this problem.

For this reason, Gotzner and Benz (2018) designed an experimental paradigm which avoided metalinguistic judgments and aimed at implementing Grice’s conversational requirements for generating implicature. They used a game-theoretic design in which interpretations are read off from test subjects’ choice of action. Grice’s purpose or direction of the talk exchange is provided by an explicit decision problem, choosing a set of rewards based on the interpretation of an utterance. In the experimental scenario, each of four girls owns a set of four special edition marbles (extending the scenario by Degen and Goodman 2014). The marbles get lost during play, and in the end they have to find them again. Their mother motivates them by promising rewards which depend on how many of their marbles they find. A girl gets (i) chocolate if she finds all 4 of her marbles, (ii) candy if she finds fewer than 4 of her marbles and (iii) a gummy bear when she finds none of her 4 marbles (as a consolation prize). The task of the participants is to buy sweets for the four girls depending on the statements the mother utters. For example, if the mother says (N-Any) ‘None of the girls found any of her marbles’ participants should only buy gummy bears. Participants were asked to give binary responses (yes/no) for each of the three types of sweets: chocolate, candy and gummy bears. Subjects were instructed to

5 In fairness, it has to be pointed out that Geurts and Pouscoulous (2009) intended to disprove Chierchia’s (2004) assumption that embedded implicature are default inferences triggered by the logical form of sentences. Their results may pose problems for this particular semantic theory.

6 Of the aforementioned studies by (Chemla 2009, Chemla and Spector 2011, Benz and Gotzner 2014, Potts et al. 2016, Franke et al. 2017), that by Chemla (2009) is arguably the least affected. He also reports the highest percentages of pragmatically answering subjects.
buy all the sweets that are needed but not more than that. If the mother says ‘all found some marbles’, then for subjects drawing the local implicature ‘all found some but not all’ the best response is to buy hard candy only. If they only draw the weaker implicature ‘not all found all’, then it is better to buy both hard candy and chocolate. If the mother says ‘some found some marbles’, then subjects inferring the global implicatures listed in (2) should buy gummy bears and hard candy but no chocolate. Gotzner and Benz (2018) implemented this scenario in an MTurk experiment. Subjects saw sentences produced by the mother and had to decide by ticking off yes/no buttons which of the sweets they had to buy.

The results indicated that subjects draw the strong local implicature (97%) for test sentence ‘All of the girls found some of their marbles’, and the strong global implicature (87%) for test sentence ‘Some of the girls found some of their marbles’. Hence, this experiment showed that, in a context that satisfies Grice’s conversational requirements, controversially discussed embedded implicatures can be reliably drawn.

One limitation of the study by Gotzner and Benz (2018) is that it only tested the comprehension of certain embedded implicatures in two possible worlds. In the current study, we develop an interactive version of the best response paradigm, which provides both comprehension and production data for a variety of utterance combinations in seven possible worlds. The main research question we address in this collaborative scenario is: To what extent can speakers shorten their description of a state of affairs without jeopardizing communicative success? The shortest descriptions will then reveal all the implicatures that can be communicated reliably in a given communicative context.

3. The interactive best response paradigm: Background

In the following, we describe the background assumptions for our interactive best response paradigm. Let us again consider the marble scenario from Gotzner and Benz (2018). A situation in which two girls found all of their marbles and two found some of them is shown in Figure 1. The mother can describe this situation by saying, for example, ‘Ann found all of her marbles, but not...'
Mary found all, Sue found some, and Kate found some.’ As it does not matter how the individual girls performed in the marble scenario, only whether there are girls that found none, some, or all of the marbles, the mother could also say (E-A & E-E) ‘Some of the girls found all of their marbles, and some found some.’ Intuitively, this should communicate enough information for the addressee to buy the appropriate sweets. However, it is not a literal description of the situation. The second use of ‘some’ leaves open whether or not all found all marbles. Hence, the mother could have said more precisely (E-A & E-ENA) ‘Some of the girls found all of their marbles, and some found some but not all.’ This is not a literal description either as it leaves open the possibility of some finding nothing. To rule out this possibility, the mother should have said (E-A & E-ENA & N-N) ‘Some of the girls found all of their marbles, some found some but not all, and none found none.’ If we start with the full literal description of the scene, then the short description E-N & E-E can be derived by first eliminating the ‘not all’ part of ‘some but not all’, and then by elimination of ‘none found all’, as shown in (4).

<table>
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<tr>
<td>E-N &amp; E-E &amp; N-A</td>
<td>elimination: ENA → E</td>
</tr>
<tr>
<td>E-N &amp; E-E</td>
<td>elimination: N-A → –</td>
</tr>
</tbody>
</table>

Our hypothesis is that all that can be eliminated by these two rules can be left unsaid without reducing chances of communicative success. If more is left unsaid, i.e. if the utterance is shorter than E-N & E-E in the situation of Figure 1, then communication becomes unreliable. The two rules can then be used to derive the shortest reliable descriptions of each possible world. To do this, we first have to define what the possible worlds and their possible descriptions are. We begin with the latter.

We consider sentences of the form (Q-Q’) ‘Q of the girls found Q’ of their marbles,’ where Q and Q’ were one of the quantifiers ‘some’ or ‘all’. To describe the situation in Figure 1, the mother may also want to use ‘none’ and ‘some but not all’. She may also want to use ‘some and possibly all’, and ‘any’ in a negative context. To produce literal descriptions of situations it is also sometimes necessary to build conjunctions of Q-Q’ sentences. We use abbreviations for referring to these sentences. If Q and Q’ are the quantifiers ‘all’, ‘some’, or ‘none’, then the following abbreviations are used:

<table>
<thead>
<tr>
<th>A-A</th>
<th>all found all</th>
<th>E-A</th>
<th>some found all</th>
<th>N-A</th>
<th>none found all</th>
</tr>
</thead>
<tbody>
<tr>
<td>A-E</td>
<td>all found some</td>
<td>E-E</td>
<td>some found some</td>
<td>N-E</td>
<td>none found some</td>
</tr>
<tr>
<td>A-N</td>
<td>all found none</td>
<td>E-N</td>
<td>some found none</td>
<td>N-N</td>
<td>none found none</td>
</tr>
</tbody>
</table>

For the more complex construction ‘some but not all’ we write ENA. For ‘any’ we write ‘Any’. We abbreviate conjunctions by combining sentences with ‘&’.

With these sentences, it is possible to distinguish seven possible worlds that are definable by whether or not the sentences E-A, E-ENA, and E-N are made true by them. We use pictograms for referring to these worlds. They are shown and defined in the next table:
In the marble scenario each situation is represented by one of the possible worlds, for example, Figure 1 represents world 4.

Next, we define a literal description of each of the possible worlds by conjoining their defining basic sentences in (6), except for the first three worlds for which universally quantified or negated basic descriptions exist. Then we simplify these descriptions by application of the two elimination rules.

We derive two production strategies, the critical strategy defined by elimination rules and the corresponding literal strategy. They are shown in (7).

As we stated before, our assumption is that the application of the two elimination rules will not change communicative success. This means that the critical production strategy has the same degree of communicative success as the literal strategy. Communication is successful if the hearer interprets an utterance as intended by the speaker. Degree of communicative success can then be measured by the proportion of utterances that are correctly understood. We further assume that any additional eliminations will lead to utterances that are too short to communicate successfully.

4. Experiments

4.1. Goals and rationale

The goal of the first experiment is to implement an interactive version of the best response paradigm involving a comprehension and a production side. This experiment is set up as a game involving groups of up to 4 participants in the lab. The system always pairs two par-
participants, a speaker and hearer. The speaker is shown a picture and his task is to describe the state of affairs with up to five sentences. Then, this utterance is sent to another participant, the comprehender. The comprehender’s task is to choose a set of rewards, reflecting his interpretation of the speaker’s utterance. Communication between the two individuals is successful, if the hearer has chosen the appropriate set of rewards for the state of affairs the speaker described. In our analysis, we measure the relative success rate and utterance length of different production strategies based on the comprehension data. In Experiment 1a, we test the critical strategy defined in Section 3 and compare it to a strategy based on literal descriptions. The main research question of the second experiment is whether the critical strategy can be further shortened without jeopardising communicative success. We will first present the methodology of both experiments together and then describe the results.

4.2. Methods

4.2.1. Apparatus

For our experiments, we programmed a system in Python using the GUI toolkit wxPython\textsuperscript{8}, which allowed us to implement a game with four participants. Participants were seated in a lab with four computers separated by a booth. The computers (DELL Optiplex 3020, 4GB RAM, Windows 8.1 Enterprise) each had an LG monitor with a resolution of 1920 $\times$ 1080 and a refresh rate of 64 Hz (15.62 ms). The system controlled stimulus presentations and pairings of participants. The system itself is based on a server-client architecture, where each client corresponds to a participant, while the server connects those clients, sends messages back and forth, pre- and post-processes the data and saves the results.

In general, the system allows to run experiments with either two or four subjects. Furthermore, it is possible to use only one (or three) computers, while the second (the fourth) PC/participant is replaced by the system itself (as was done in Experiment 1b), acting according to a predefined plan to investigate production strategies in a controlled manner.

4.2.2. Experiment 1a

**Participants** Participants were recruited via a subject pool of the Psychology Department from Humboldt University. In total, 38 German participants (21 female, 17 male, mean age: 29.3) took part in the experiment. Participants took the experiment in groups of varying sizes: there were groups with 4 players, groups with 2 players, and groups with 3 players in addition to the experimenter, who played the critical strategy (see Section 3). 8 participants took part in the version with 4 players (2 groups), 10 participants in the version with two players (5 groups) and 18 participants in the version with 3 players (6 groups). Finally, 2 participants played a version with 1 player in addition to the experimenter (2 groups). These two participants were not included in the analysis reported below.

\textsuperscript{8}https://www.wxpython.org/
The mother says: ‘Each girl found all of her marbles’

<table>
<thead>
<tr>
<th>Sweets</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chocolate</td>
<td>⊙YES</td>
<td>NO</td>
</tr>
<tr>
<td>Candy</td>
<td>⊙YES</td>
<td>NO</td>
</tr>
<tr>
<td>Gummy bear</td>
<td>⊙YES</td>
<td>NO</td>
</tr>
</tbody>
</table>

Table 1: Example item each-all with example response choice, participants were asked to check a radio button for each type of sweets.

**Scenario** Participants in our experiment were presented with a scenario involving six girls who each own a set of four special edition marbles (extending the basic best response paradigm by Gotzner and Benz 2018). While the girls are playing the marbles get lost and they have to find them again. Participants in our experiment were told that the nursery school teacher of the girls wants to reward them depending on how many marbles the girls find. In particular, participants were presented with the following reward system in the instructions:

A girl gets:

- chocolate if she finds all 4 of her marbles
- candy if she finds fewer than 4 of her marbles
- a gummy bear when she finds none of her 4 marbles (as a consolation prize).

**Experimental tasks** Participants were randomly assigned to two different roles in the experiment: a speaker or a comprehender. The speaker saw a picture showing the marbles each girl had found, representing all seven possible worlds. The seven worlds we distinguished corresponded to the model presented in Section 3.

The task of the speaker was to describe the picture so that the comprehender can buy the appropriate sweets for the girls. Participants were presented with a sentence frame and they were required to fill in two blanks. They were allowed to type in one of the following words or phrases: all, some, none, some but not all, some and possibly all and any (in German). Participants were allowed to produce up to five sentences to describe a given picture. Participants’ responses were checked for spelling by the system. If they used a word which was not allowed, the corresponding box was highlighted and they had to correct their response.

When the speaker was done describing the picture, the comprehender received his message. The comprehender’s task was to select the appropriate kind of sweets for the six girls depending on the message he received. An example trial with the utterance ‘Each girl found all of her marbles’ and the appropriate response choice is presented in (1). Participants gave their response by checking one of two radio buttons for each type of sweets.

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9In this experiment we introduced six girls rather than four in order to avoid referring to a single entity with some. Even though the basic semantics of some is existential, the quantifier most naturally denotes a set of at least two items (see for example Degen and Tanenhaus 2015 and van Tiel 2014).
In Experiment 1a, we used a confederate, the experimenter, who produced the critical utterances outlined in Section 3.

**Procedure**  At the start of a session, participants were presented with instructions describing the basic setup of the experiment. We told them about the scenario and the different roles they have to take during the experiment. After participants had read the instructions, they performed seven practice trials to learn the reward system used in the comprehender’s task. During practice trials, participants saw a picture representing the state of the world and had to chose the appropriate sweets (while during test trials, participants chose the appropriate sweets based on an utterance produced by the speaker). The system checked the responses and reported an error if participants chose the wrong sweets.

In the main part of the experiment, participants were assigned to the two different roles in succession. That is, in a given experimental block, a participant either described a picture or interpreted an utterance he received. In these critical trials, no feedback was given by the system so that participants were not biased to pursue a certain interpretation. Each participant took every role 3 times during the course of the experiment. Hence, there were 6 experimental blocks in total. The system always paired two participants for a given world-message pair. For example, the first participant produced a description of the picture and then the second participant received this description and had to chose the reward depending on the statement(s). The pairing of the subjects varied from round to round to make sure each participant plays with every other participant and adopts both roles.

One experimental block consisted of 7 trials representing the different worlds (randomized across the different blocks). The system waited until all participants made their responses and then the next trial was initiated. While the producer typed in a description of the current picture, the comprehender had to wait and vice versa. In the 4 and 3 participant versions, we obtained a total of 82 observations (production/comprehension pairs). In the 2 participant versions, there were 41 observations in total.

4.2.3. Experiment 1b: Shortening strategy

**Participants**  In total, 20 German participants (13 female, 7 male, mean age: 31.0) took part in the second experiment. In Experiment 1b, there were four groups with 3 players and the critical production strategy was fed in by the system. In two sessions 4 participants took part and the production data of these participants were saved and replaced by the computer strategy.

**Materials**  Participants were presented with the same instructions and scenario as in Experiment 1a.

In Experiment 1b, we tested whether the critical strategy can be further shortened and therefore included the following three simple utterances:
1. Some of the girls found some of their marbles (E-E)

2. Some of the girls found all of their marbles (E-A)

3. Some of the girls found none of their marbles (E-N)

In worlds N-E, A-E and A-A we used the same critical utterances as in Experiment 1a. And for world N-N we tested the utterance N-N, which is not relevant for the shortening of utterances.

**Procedure** The procedure was the same as in Experiment 1a except that there were no groups in which the experimenter took part. Instead of using the experimenter as a confederate, the shortening strategy was fed in by the system. That is, if only 3 participants played the game, the critical messages were sent by the computer. In 2 groups, 4 participants came and we saved the production data of the fourth participant and fed in the critical strategy instead. The comprehension data were used from all participants.

4.3. Results

4.3.1. Experiment 1a

We analysed participants’ success rate (expected utility) as a function of whether the hearer selected the appropriate sweets depending on the picture the speaker saw. Only if the hearer selected all required sweets correctly was the choice considered a success. Overall, the success rate was quite high (89.7 %), showing that participants understood the task. We, then evaluated how successful different production strategies were, also taking into account utterance length. A t-test showed that the critical strategy was significantly more successful than the average participant strategy (t = -3.85, p-values < .001) and it was also significantly shorter in terms of mean utterance length (t = 6.13, p-values < .001). Table 4.3.1 compares the success rate of the critical and literal strategy in each individual world. Interestingly, when participants produced exact descriptions such as Each girl found some but not all of her marbles the communicative success was not better compared to utterances where the short form was used. Hence, for each world the critical strategy was at least as successful as the literal strategy and shorter in terms of utterance length.

4.3.2. Experiment 1b

To show that the critical strategy is the most efficient one, we need to establish that shortening utterances any further lowers communicative success. In Experiment 1b, we replicated the findings concerning the success rate of the utterances also used in Experiment 1a (detailed results are shown in (8) in the Appendix). In the following, we focus on the results of the critical
Table 2: Results Exp. 1a: Success rate of critical and literal strategy per world (# int: absolute number of items interpreted by subjects).

<table>
<thead>
<tr>
<th>world</th>
<th>critical strategy</th>
<th>literal strategy</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td># int.</td>
<td>% success</td>
</tr>
<tr>
<td>N-Any</td>
<td>49</td>
<td>100%</td>
</tr>
<tr>
<td>A-E</td>
<td>36</td>
<td>94%</td>
</tr>
<tr>
<td>A-A</td>
<td>114</td>
<td>99%</td>
</tr>
<tr>
<td>E-E &amp; E-N</td>
<td>37</td>
<td>95%</td>
</tr>
<tr>
<td>E-A &amp; E-N</td>
<td>52</td>
<td>96%</td>
</tr>
<tr>
<td>E-A &amp; E-E</td>
<td>41</td>
<td>98%</td>
</tr>
<tr>
<td>E-A &amp; E-E &amp; E-N</td>
<td>48</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 3: Results Exp. 1b: Success rate of shortening strategy per world.

<table>
<thead>
<tr>
<th>short utterances</th>
<th>critical</th>
<th>literal</th>
<th>average</th>
</tr>
</thead>
<tbody>
<tr>
<td>E-E</td>
<td>-</td>
<td>32%</td>
<td>-</td>
</tr>
<tr>
<td>E-A</td>
<td>-</td>
<td>11%</td>
<td>5%</td>
</tr>
<tr>
<td>E-N</td>
<td>11%</td>
<td>6%</td>
<td>74%</td>
</tr>
</tbody>
</table>

The success rate of the short utterances was lower than that of the critical strategy. We computed a one sample t-test with the lowest success rate of the critical strategy as expected value (94%), which found the differences to be significant (t = 6.25, p < .05).

Finally, in Table 4, we present an overview of the average success rate and utterance length of the critical strategy, the literal strategy and participants’ average strategy (taking into account the data from both experiments for all seven worlds).

<table>
<thead>
<tr>
<th>strategy</th>
<th>mean utterance length</th>
<th>%success</th>
</tr>
</thead>
<tbody>
<tr>
<td>average</td>
<td>2.09</td>
<td>89%</td>
</tr>
<tr>
<td>critical</td>
<td>1.71</td>
<td>97%</td>
</tr>
<tr>
<td>literal</td>
<td>2.5</td>
<td>93%</td>
</tr>
</tbody>
</table>

Table 4: Comparison of mean utterance length and success rate of different production strategies (average of Experiments 1a and 1b).

In sum, these data demonstrate that the critical strategy is maximally efficient in the sense that it is equally successful as the corresponding literal strategy and cannot be shortened without introducing interpretative uncertainty.

5. Discussion

In two experiments we tested our new interactive paradigm. We showed that participants reliably communicate embedded and unembedded implicatures in our interactive setting. This
confirms Grice’s central requirement for implicature: contextual relevance. Our data confirmed our main hypotheses: The critical strategy is as successful as the corresponding literal strategy, and shortening it further significantly reduces communicative success. The results, thereby, support the hypothesis that the two proposed elimination principles (ENA-Elim and N-X-Elim) characterize what can be left unsaid.

Whereas previous experimental studies focused on the comprehension of a few test sentences in isolation, we have gathered data on a variety of utterance combinations in a precise communicative context. Some previous studies had already indicated that embedded implicatures exist (Chemla 2009, Clifton Jr and Dube 2010, Chemla and Spector 2011, Benz and Gotzner 2014, Potts et al. 2016, Franke et al. 2017, Gotzner and Romoli 2017). However, the experimental paradigms used by these studies have been criticized for being unnatural or being prone to typicality effects (see especially Geurts and van Tiel 2013, van Tiel 2014). What is more, our goal was to show that, in a context that makes certain implicatures relevant, they should be reliably communicated, that is as successfully as corresponding literal descriptions. In our new interactive best response paradigm, we have implemented contextual relevance as an explicit decision problem, choosing a set of rewards. We believe that our action-based task, which distinguishes between relevant readings, is the crucial reason why implicatures are communicated successfully (see Gotzner and Benz 2018). In turn, the meta-linguistic tasks used in previous studies (inferential and truth value judgments) seem to highlight the ambiguity between implicature-based responses and literal interpretations of an utterance.

We now turn to theoretical implications of the current results. The model we based our critical strategy on was developed as a refinement of the game-theoretic model of (Benz 2012), but, for the purposes of this paper, we can keep a relatively theory-neutral position. However, there are two sentences that are particularly problematic for globalist theories (e.g. Sauerland 2004). They are E-E ‘Some of the girls found some of their marbles’, and E-E & E-A ‘Some of the girls found some, and some found all’. Our model predicts that E-E will fail to reliably communicate the state of the world, and that E-E & E-A communicates that the actual world is \( \Box \). Gricean globalism predicts that E-E implicates that not A-E ‘all some’ and not E-A ‘some all’, and, hence, that E-E implicates \( \Box \). For E-E & E-A we find the stronger alternative A-E & E-A, hence, Gricean globalism predicts the negation of A-E & E-A, and, therefore, that the speaker meant \( \Box \) or \( \Box \). However, we have seen that it is reliably interpreted as \( \Box \). We find here a clear conflict between our experimental results and the globalist principle by which sentences implicate the negation of their stronger alternatives. Other theories, in general, do not make predictions that are specific enough to decide whether they are in conflict with our model or not. This does not mean, however, that there are no problems. For example, there is no simple explanation in the standard localist model of (Chierchia et al. 2012) for why E-E & E-A implicates that none found none.

6. Conclusions

Our experiments demonstrated that, in an interactive context involving a speaker and a hearer, embedded implicatures are reliably communicated. We also presented a critical production strategy that was defined by two rules that allow simplifications of literal descriptions. These
rules were i) the rule that ‘some but not all’ can be simplified to ‘some’, and ii) the rule that conjuncts stating that ‘none found X’ can be eliminated. In our experiments, the critical strategy was maximally efficient in the sense that it a) communicated the state of the world as reliably as the literal strategy from which it was derived, and b) could not be shortened further without losing communicative success.

Our new paradigm opens up the possibility to investigate a variety of sentences of particular theoretical interest in a controlled manner. The advantage is that the sentences are embedded in a natural communicative situation in which subjects are more strongly immersed in the experimental setting. The software that we developed can be used to test speaker-related and other contextual factors, for example by using a confederate. This is done in such a way that subjects do not notice that sentences have not been produced by an actual dialogue partner. On request, we will make the system available to researchers. We hope that our new paradigm will spark further research on implicatures in interactive settings with controlled dialogue.

References

A. Summary results

Results for critical and literal strategy in Experiment 1b (# int: number of items that had been presented to subjects for interpretation):^10

^10The absolute numbers of literal utterances were lower in Exp. 1b than in Exp. 1a due to the lower number of participants.
Results for critical and literal strategy for the accumulated data of both experiments (# int: number of items that had been presented to subjects for interpretation):

<table>
<thead>
<tr>
<th>World</th>
<th>Critical Strategy</th>
<th># Int</th>
<th>% Success</th>
<th>Literal Strategy</th>
<th># Int</th>
<th>% Success</th>
</tr>
</thead>
<tbody>
<tr>
<td>(8)</td>
<td>N-Any</td>
<td>37</td>
<td>100%</td>
<td>N-Any</td>
<td>37</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>A-E</td>
<td>24</td>
<td>92%</td>
<td>A-ENA</td>
<td>25</td>
<td>92%</td>
</tr>
<tr>
<td></td>
<td>A-A</td>
<td>60</td>
<td>95%</td>
<td>A-A</td>
<td>60</td>
<td>95%</td>
</tr>
<tr>
<td></td>
<td>E-E &amp; E-N</td>
<td>5</td>
<td>100%</td>
<td>E-ENA &amp; E-N &amp; N-A</td>
<td>3</td>
<td>67%</td>
</tr>
<tr>
<td></td>
<td>E-A &amp; E-E</td>
<td>22</td>
<td>86%</td>
<td>E-A &amp; E-N &amp; N-ENA</td>
<td>6</td>
<td>67%</td>
</tr>
<tr>
<td></td>
<td>E-A &amp; E-N</td>
<td>5</td>
<td>100%</td>
<td>E-A &amp; E-ENA &amp; N-N</td>
<td>1</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>E-A &amp; E-E &amp; E-N</td>
<td>8</td>
<td>100%</td>
<td>E-A &amp; E-ENA &amp; E-N</td>
<td>10</td>
<td>90%</td>
</tr>
</tbody>
</table>

Note that the number of items presented to subjects include those that had been produced by a confederate (experimenter in Exp. 1a, system in Exp. 1b).

Notation  Quantifiers within one utterance are separated by ‘-‘ and ‘&’ represents conjunction of multiple utterances; A = all, E = some, N = none, ENA = some but not all.
Modal height and modal flavor: The case of Wolof di
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Martina MARTINOVIĆ — University of Florida

Abstract. The Wolof imperfective auxiliary di is compatible with event-in-progress, habitual and future readings. Furthermore, while varieties of all these readings are available for di when it sits in a syntactically low position, only future readings are available when it sits in a syntactically high position. We aim to account for this puzzle by combining several ingredients independently motivated in the literature: (i) event-relative circumstantial modality for event-in-progress, habitual, and a subset of future readings; (ii) metaphysical modality for generalized future readings; (iii) the idea that syntactic height determines the type of modal anchor that projects a modal base. This study contributes to our understanding of the relation between syntactic height and modal flavor, as well as the nature of modal-aspectual interactions cross-linguistically.

Keywords: aspect, future, habitual, imperfective, modality, modal flavor, progressive.

1. The puzzle

The central puzzle discussed in this paper has two parts, and concerns the verbal auxiliary di in Wolof (Niger-Congo). First, di – glossed as ‘imperfective’ in the descriptive literature – is associated with several readings (Church, 1981; Robert, 1991): an event-in-progress/progressive reading as in (1); a habitual reading as in (2); and a future reading as in (3).

(1) Progressive reading; low di
Dafa di (> dafay) añ, mën-ul ñëw.
do.C.3SG IMPF eat.breakfast can-NEG come
‘Il est en train de manger, il ne peut pas venir.’
‘He is eating, he cannot come.’ (Robert, 1991: p. 263)

(2) Habitual reading; low di
Dafa di (> dafay) jaay,
do.C.3SG IMPF sell

We would like to thank our consultants, Jean-Lópold Diouf, Mbaye Diop, Magatte Diop, Abdou Aziz Djakhate, Alioune Kebe, Ismaïle Kebe, and Louis Camara. For comments on this work, we are grateful to Ana Arregui, Peter Klecha and Maribel Romero, as well as audiences at the University of Konstanz, Triple A 4 in Gothenburg and SuB in Potsdam. This work was partially supported by an Alexander von Humboldt Fellowship (Bochnak), and by the DFG-funded IGRA Graduate School at the University of Leipzig (Martinović).

2 “Inaccompli” in Church 1981 and Robert 1991; we use the gloss IMPF ‘imperfective’ in this paper.

3 Data from Robert 1991 uses translations and context descriptions in French. The English translations are our own. Examples not otherwise marked are from Martinović’s fieldwork. The notation Dafa di (> dafay) invokes the pronunciation whereby di cliticizes to the previous phonological word as is pronounced -y (IPA [j]) after a vowel-final word.

4 Abbreviations: C = complementizer, CM = class marker, DEF = definite, IMPF = imperfective, INDEF = indefinite, LCL = locative clitic, NEG = NEGATION, PL = plural, SG = singular.
(3) **Future reading; low di**

Context: devant la maison en construction/in front of a house under construction
Kii mu-a di (> mooy) rafet kër!
this.one 3SG-C IMPF be.pretty house
‘Elle va être drôlement belle, sa maison, à lui!’/‘It’s going to be really beautiful, this one’s house.’ (Robert, 1991: p. 269)

In comparison, a clause with an eventive verb without di such as (4) only receives an episodic, default past interpretation. Clauses with stative predicates without di have a default present reading, as in (5).\(^5\)

(4) **Episodic reading with eventive; no di**
Xale yi lekk-na--gnu ceeb.
child DEF.PL eat-C-3PL rice
‘The children ate rice.’

(5) **Present reading with stative; no di**
Mbaye bég-na-θ.
Mbaye be.happy-C-3SG
‘Mbaye is happy.’

The second part of the puzzle is the fact that the availability of these readings depends on di’s structural position. In (1)-(3), when di is in its base-generated position in Asp (“low di”), all readings are available. However, when di is in C (in non-copular sentences), only the future is possible, as in (6) (Martinović, 2015). The context description (from Robert) indicates that an event-in-progress reading is not possible for “high di”; we will show later that a habitual reading is also not possible for high di.

(6) **Future reading; high di**
Di-na-θ gor garab bi.
IMPF-C-3SG cut tree DEF.SG
‘(À ce moment là) il abattrait l’arbre.’/(At that time) He’s going to cut the tree.’
[impossible if he is already trying to cut it] (Robert, 1991: p. 272)

Whereas Robert (1991) took the different readings of di in the different positions as evidence for two distinct lexical items, in this paper we aim to provide a unified analysis of di that derives all the attested readings.

In particular, we aim to provide a unified analysis of the readings of di by combining and expanding on several independently motivated analysis for progressives, habitualls, and modality in the literature. First, we follow Portner (1998) and Ferreira (2016) in claiming that event-in-progress and habitual readings crucially involve event-relative circumstantial modality. We

\(^5\)Note that Wolof is an optional tense language (Bochnak and Martinović, 2017), but we only show tenseless clauses here (see Smith (1997); Smith and Erbaugh (2005) for an account of default readings of tenseless clauses in other languages).
then extend this idea to cover a subset of future readings, arguing that all readings of low \textit{di} can be captured using an event-relative circumstantial modal base. We then argue that future readings for high \textit{di} are derived from a metaphysical modal base, following Condoravdi (2002); Kaufmann (2005), and others. Given that the availability of different readings for \textit{di} when it is located in different syntactic positions, we argue that this behavior of \textit{di} provides new evidence for the idea that modal height correlates with modal flavor, following Hacquard (2010); Kush (2011). Specifically, following Kush (2011), we argue that different modal bases are available at different syntactic heights because of the availability of different types of modal anchors from which a modal base is projected, and that the semantic type of \textit{di}’s complement determines the type of the modal anchor. This work thus contributes to our understanding of the relation between syntactic height and modal flavor, as well as the nature of modal-aspectual interactions cross-linguistically.

The rest of the paper is organized as follows. In section 2 we provide more background on the Wolof language and the syntactic analysis of \textit{di} that we assume, and in section 3 we provide more data that corroborate the empirical picture sketched here in the introduction. In section 4 we introduce a proposal for event-in-progress and habitual readings in terms of event-relative circumstantial modality, following Portner (1998) and Ferreira (2016). In section 5 we sketch how future readings can be incorporated into this view, but also point out its shortcomings, arguing for a metaphysical modal base for future readings of high \textit{di}. We connect the (un)availability of certain readings for \textit{di} with its syntactic position in section 6, following ideas from Kush (2011). Section 7 concludes.

2. Background on Wolof and syntax of \textit{di}

Wolof is a Niger-Congo language of the West-Atlantic branch. It is spoken by around 5.2 million people in Senegal, where it is also the lingua franca, and as a minority language in the Gambia and Mauritania (Leclerc 2015). The data in this paper come largely from Martinović’s fieldwork in Saint-Louis, Senegal, during 3 trips undertaken between 2014 and 2017.

Wolof finite indicative clauses all have a CP-layer, hosting complementizer-like elements (Dunigan 1994; Martinović 2015). Syntactically, there are two clause-types (Martinović, 2015). The first type is non-\textit{wh}-movement clauses, where a verbal element necessarily appears in C. This can be the lexical verb, as in (7), the dummy verb \textit{def} ‘do’\textsuperscript{6}, exemplified in (8), or the imperfective auxiliary \textit{di}, shown in (9).

\begin{itemize}
  \item \textbf{(7) \textit{Main verb in C}}
  Demba \textbf{tabax-na-\textit{\texttt{\textcircled{0}}}} kër.
  Demba build-C-\textit{3SG} house
  ‘Demba built a house.’
  \item \textbf{(8) \textit{‘Do’ (\textit{def}) in C}}
  Demba \textbf{daf-a-\textit{\texttt{\textcircled{0}}}} tabax kër.
  Demba do-C-\textit{3SG} build house
  ‘Demba BUILT a house.’
\end{itemize}

\textsuperscript{6}The \textit{do}-support clauses express V/VP focus. We use all caps in the translation to indicate this.
(9) **Imperfective auxiliary** *di* **in C**
Demba di-na-∅ tabax kër.
Demba IMPF-C-3SG build house
‘Demba will/is going to build a house.’

The second clause-type is *wh*-movement clauses in which an element moves to Spec,CP. There is no verbal element in C in this case.

(10) **Wh-question**
Lan la Demba tabax?
what C Demba build
‘What did Demba build?’

(11) **Relative clause**
kër g-i Demba tabax
house C'M-C Demba build
‘the house which Demba built’

The imperfective morpheme *di* is a verbal head, as evidenced by its syntactic behavior. First, when it is the highest verbal element in the clause, it raises to C (see (9)). Second, if it is present in the clause, other verbal functional morphology (negation and tense) suffixes onto it, and not onto the lexical verb as shown in (13).

(12) **Main verb with negation**
Demba daf-a-∅ tabax-ul ay kër.
Demba do-C-3SG build-NEG INDEF.PL house
‘Demba didn’t BUILD houses.’

(13) **Di with negation**
Demba daf-a-∅ d(i)-ul tabax ay kër.
Demba do-C-3SG IMPF-NEG build INDEF.PL house
‘Demba won’t BUILD houses.’/’Demba isn’t BUILDING houses.’/’Demba doesn’t BUILD houses.’

Phonologically, *di* behaves as a clitic. When there are no suffixes, it forms a phonological unit with the material in C and pronominal clitics that follow it. In that case, it is pronounced as -*y*, as in (14).7

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7Robert (1991) considers *di* and -*y* to be different morphemes. There is good evidence that this is not the correct analysis. For example, in certain situations, like in biclausal progressives, an adjunct can intervene between the imperfective morpheme and the preceding phonological word. When the adjunct is absent the imperfective is pronounced as -*y*, when present, it surfaces as *di*, shown in (i) and (ii). (See Martinović and Schwarzer (forthcoming) for more on Wolof progressives.)

(i) Ma-a-ngi di (> maangi) lekk.
1SG-C-LCL IMPF eat
‘I am eating.’

(ii) Ma-a-ngi ci tiitange di lekk.
1SG-C-LCL in fear IMPF eat
‘I am fearful, eating.’
(14) **Di as a clitic**
Demba daf-a-θ=ko di (> koy) tabax.
Demba do-C-3SG=it IMPF build
‘Demba will BUILD it.’/’Demba is BUILDING it.’/’Demba BUILDS it.’

We assume that *di* occupies an Asp head below T (as in (15)), and in clauses with V in C raises to C (in (16)):

(15)
```
CP
  C
    TP
      T
        AspP
          Asp
            VP
              di
```

(16)
```
CP
  C
    TP
      T
        C
          t
            AspP
              Asp
                T
                  VP
                    di
```

3. The empirical picture

In general, the readings that we have seen are available for all aspectual classes. As we have seen, low *di* is compatible with an event-in-progress readings, as in (17). If the event is an achievement, the reading obtained is an iterative one, as in (18).

(17) **Low di event-in-progress; accomplishment**
[CONTEXT: I am standing in front of a wall with a bucket of paint and I just put a brush to the wall and started drawing something. Someone walks into the room and asks What are you doing? I respond:] Da-ma di (> damay) rëdd wërëngëë. do.C-1SG IMPF draw circle
‘I am drawing a circle.’

(18) **Low di event-in-progress; achievement**
[CONTEXT: I hear a repetitive noise from another room, and I ask what that is. Someone answers me:] Dudu daf-a-θ di (> dafay) tisooli. Dudu do-C-3SG IMPF sneeze
‘Dudu is sneezing.’
A habitual reading is also possible when \( \text{di} \) is in the low position, as shown in (19) and (20).

(19) **Low \( \text{di} \) habitual; accomplishment**

[CONTEXT: My friend Fatou goes around and draws circles on walls every Monday. Another friend has seen her a few times walking around with a bucket of paint, and asks me what that’s about. I tell him:]

Altine b-u nekk, Faatu daf-a-\( \emptyset \) di (\( \text{>dafay} \)) rëdd ay \( \text{wërëngërël} \).

Monday CM-C be, Fatou do-C-3SG IMPF draw INDEF.PL circle

‘Every Monday, Fatou draws circles.’

(20) **Low \( \text{di} \) habitual; stative**

[CONTEXT: Magatte visits her village rarely, only once every two years, but whenever she goes there, her friend Binta is pregnant. Magatte comments to her mother:]

Binta daf-a-\( \emptyset \) di (\( \text{>dafay} \)) \( \text{êmb} \) rekk!

Binta do-C-3SG IMPF be.pregnant only

‘Binta is always pregnant!’

Meanwhile, future readings are available for both low and high \( \text{di} \). Examples (21) and (22) show this for low \( \text{di} \); (23)-(26) show this for high \( \text{di} \).

(21) **Low \( \text{di} \) future; accomplishment**

[CONTEXT: I see Mbaye walking around the town with an architect, buying building materials, etc., and I ask our mutual friend what Mbaye is up to, and he tells me:]

Mbaye daf-a-\( \emptyset \) di (\( \text{>dafay} \)) tabax kër.

Mbaye do-C-3SG IMPF build house

‘Mbaye is going to build a house.’

(22) **Low \( \text{di} \) future; stative**

[CONTEXT: Fanta and her husband Ibrahim cannot conceive a child, so they go to see a ‘doctor’ who uses local plants and herbs to make medicine. He gives them a tea and tells Fanta to drink it every day, promising:]

Fanta daf-a-\( \emptyset \) di (\( \text{>dafay} \)) \( \text{êmb} \).

Fanta do-C-3SG IMPF be.pregnant

‘Fanta is going to get pregnant.’

(23) **High \( \text{di} \) future; accomplishment**

[CONTEXT (same as (21)): I see Mbaye walking around the town with an architect, buying building materials, etc., and I ask our mutual friend what Mbaye is up to, and

\(^8\)Generic readings are also possible for low \( \text{di} \), as shown in (i). We set aside these readings for the rest of the paper, though we are hopeful they can be accounted for under the analysis we pursue; see Deo 2009 for unifying event-in-progress, habitual, and generic readings of imperfectives.

(i) jant bi, penku la di (\( \text{>lay} \)) fenke

sun DEF.SG east C IMPF rise

‘Le soleil, c’est à l’est qu’il se lève.’

‘The sun, it’s in the east that it rises.’ (Church, 1981: p. 114)
he tells me:

Mbaye di-na-Ø tabax kër.
Mbaye IMPF-C-3SG build house
‘Mbaye is going to build a house.’

(24) **High di future; stative**

**CONTEXT:** Fatou is making Oussman’s favorite dish for lunch and I walk in and say:

Usmaan di-na-Ø bég.
Oussman IMPF-C-3SG happy
‘Oussman is going to be happy.’

(25) **High di future; achievement**

**CONTEXT:** I am throwing a party and I ask Fatou if anyone from her family will be there. She tells me that her brother Moussa will come:

Musaa di-na-Ø ŋew.
Moussa IMPF-C-3SG come
‘Moussa will/is going to come.’

(26) **High di future; achievement**

**CONTEXT:** I am playing a game with Loulou in which we stare into each other’s eyes and try not to blink. Ibrahim is watching us and he sees that Loulou’s eyes are starting to water and that she is having trouble keeping them open. He says:

Lulu di-na-Ø xef.
Loulou IMPF-C-3SG blink
‘Loulou is going to blink.’

Only a future reading is possible for high di. The context for (27) and (28) make an event-in-progress reading or habitual reading plausible, and a future reading implausible. In such a context, speakers reject the use of high di in (28).

(27) **Low di; progressive or habitual**

**CONTEXT:** There is a party and Magatte is dancing. Her husband Mbaye does not like it when she dances in public, so he is in a bad mood. A friend asks what is wrong, and Mbaye says:

Magatte daf-a-Ø di (> dafay) fecc.
Magatte do-C-3SG IMPF dance
‘Magatte is dancing.’/‘Magatte always dances.’

(28) **High di; only future reading**

**CONTEXT** (same as (27)): There is a party and Magatte is dancing. Her husband Mbaye does not like it when she dances in public, so he is in a bad mood. A friend asks what is wrong, and Mbaye says:

#Magatte di-na-Ø fecc.
Magatte IMPF-C-3SG dance
‘Magatte is going to dance.’
In sum, when $di$ is in the low position, it is compatible with event-in-progress, habitual, or future readings. When $di$ is in the high position, only the future reading is possible. These findings are summarized in Table 1. Our analysis is an attempt to account for these two facts.

### 4. Event-in-progress and habitual readings

It has long been acknowledged in the literature that readings associated with imperfective morphemes incorporate a modal component (Dowty, 1979; Landmann, 1992; Portner, 1998; Deo, 2009; Arregui et al., 2014; Ferreira, 2016). Many of these authors have also explicitly attempted to offer a unified analysis of the several readings associated with imperfective morphology cross-linguistically, especially for event-in-progress and habitual readings. In this section, we introduce Portner’s (1998) analysis of the English Progressive, couched within a framework of event-relative modality, and Ferreira’s (2016) extension of Portner’s analysis for habituels, and map these on to the event-in-progress and habitual readings for (low) $di$ in Wolof.

#### 4.1. Portner’s analysis for event-in-progress

Following previous analyses by Dowty (1979) and Landmann (1992), Portner (1998) offers a modal analysis of the English Progressive form. The key components of Portner’s analysis are the following.

First, in a departure from a classical Kratzerian semantics for modality (Kratzer, 1981, 2012), the modality involved is *event-relative*, rather than world-relative. That is, a set of modal alternatives is projected from an event of evaluation, rather than a world of evaluation. The modal base for the Progressive operator is a circumstantial one – it consists of the set of worlds $w'$ where the circumstances surrounding event $e$ in the evaluation world $w$ also hold. Among the circumstances include properties of the event participants, such as their abilities and dispositions. The modal base is further relativized to an event description $P$. This move is important, since one and the same event may be described in different ways, but the nature of the event description has an effect on whether speakers judge a sentence containing a Progressive as true or false. Compare (29a) and (29b):

\[(29)\]  
| a. Alex was swimming westward.  
| b. Alex was swimming to New York.  

Both sentences could in principle be used to describe one and the same event qua set of actions (e.g., Alex jumps into the ocean in Portugal and begins swimming west), but we would generally judge (29b) as false if Alex is a typical human who wouldn’t have the ability to swim all the...
way across the Atlantic. The goal PP isn’t part of the event description in (29a), and so doesn’t figure in to our reasoning for deciding on its truth. An adaptation of Portner’s formalization of the modal base is given in (30):

(30) Event-relative circumstantial modal base: (cf. Hacquard 2010)

\[ \bigcap \text{CIRC}(e, P, t, w) \]

= \{ w' | w' is compatible with the circumstances surrounding e qua P-event at t in w \}

Second, in line with a Kratzerian analysis of modality, Portner makes use of an ordering source that further restricts the quantification over the modal base. For the Progressive, the ordering source is a set of propositions that represent the “set of outside factors that need to go right” (Portner, 1998: p.773) for the event in progress at the reference time to be completed. It is the set of propositions that entail that e qua P-event does not get interrupted, as in (31).

(31) Non-interruption ordering source:

\[ \text{NI}(e, P, t, w) = \{ p | p \text{ entails that e qua P-event in } w \text{ does not get interrupted after } t \} \]

The propositions in NI serve to order the worlds in CIRC. Worlds where more of the propositions in NI are true are better worlds than those where fewer propositions in NI are true. The idea is that the Progressive does not quantify over the entire modal base, but only a subset of the modal base which is ranked “best” or ideal according to the ordering source. We adapt Portner’s definition of BEST in (32), where \( w'' <_\text{NI} w' \) means that \( w'' \) is ranked better than \( w' \) according to the ordering source NI:

(32) \( \text{BEST}(\text{CIRC}, \text{NI}, w) = \{ w' \in \bigcap \text{CIRC} | \neg \exists w'' \in \bigcap \text{CIRC} \text{ where } w'' <_\text{NI} w' \} \)

The Progressive universally quantifies over the set of worlds in BEST, and those worlds (the “inertia” worlds) are those where a P-event is actually completed.

Finally, there is a temporal component to the Progressive, namely that the reference time be a non-final subinterval of the run time of the event that is completed in the inertia worlds. In other words, the event e ongoing at the reference time \( t \) is a temporal subevent of a P-event \( e' \), whose temporal trace is a superset of and extends into the future of \( t \).

Putting these pieces together, a Portner-style semantics for the Progressive can be modeled as in (33), where \( P \) is a property of events, \( \tau \) is the temporal trace function, and \( t \subset_{\text{nfin}} t' \) means that \( t \) is a non-final subinterval of \( t' \).

(33) \[ [\text{PROG}] = \lambda P(\nu,v,t)\lambda t \lambda w. \exists e[t \subseteq \tau(e) \& \forall w' \in \text{BEST}(\text{CIRC}, \text{NI}, w)[\exists e' \exists t' [t \subset_{\text{nfin}} t' \& t' = \tau(e') \& P(e', w')]]] \]

(= preliminary analysis of \( [\text{di}_{\text{low}}] \))

This analysis accounts for the possible non-actualization of a P-event in the actual world. Although the actual world will be located in the circumstantial modal base, it might not be among the set BEST according to the ordering source (i.e., if the event gets interrupted).
Let us propose that the event-in-progress reading for Wolof *di* can be modeled using (33). The sentence (17), repeated here as (34), is given the truth conditions in (35), assuming a modal base and ordering source along the lines of (35a) and (35b).  

(34) Da-ma *di* (> damay) rëdd wëëngërel.  
do.C-1SG IMPF draw circle  
‘I am drawing a circle.’  

(35) [damay rëdd wëëngërel]  
= λw.∃e∃t [t ⊆ τ(e) & ∀w′ ∈ BEST(CIRC, NI, w) [∃e′∃t′ [t ⊆ t′, w′ ∈ τ(e′) & draw(sp, c, e′, w′)])]  

a. CIRC(e, P, t, w) = {‘The speaker intends to draw a circle’, ‘The speaker knows how to draw a circle’, ‘The speaker is paying attention to the task’, ...}  

b. NI(e, P, t, w): {‘The speaker’s paintbrush doesn’t break’, ‘The speaker doesn’t run out of paint’, ‘The speaker doesn’t get distracted’, ...}

Summing up, the key ingredients of a Portner-style analysis of event-in-progress readings are an event-relative modal base (and ordering source), together with a forward-shifting temporal component (i.e., the runtime of a *P*-event extends into the future of the reference time in the inertia worlds).

4.2. Habitual readings

It is widely known that imperfectives in many languages are compatible with both event-in-progress and habitual readings (among others), and several proposals in the recent literature have emerged to make sense of this fact under a unified analysis of imperfectivity (Arregui et al. 2014; Cipria and Roberts 2000; Deo 2009; Ferreira 2016, among others). In this paper we will follow Ferreira (2016), since it is a recent analysis that explicitly and minimally extends Portner’s analysis of the Progressive for habitual readings as well.

Ferreira aims to give a generalized meaning for imperfective morphology to account for the event-in-progress/habitual syncretism found in many languages. He argues that Portner’s analysis for event-in-progress readings can be carried over straightforwardly to habitual readings as well, with one important innovation: event plurality. Specifically, Ferreira argues that the imperfective can apply to singular or plural events. When the imperfective applies to a singular event, the event-in-progress reading obtains; when applied to plural events, the imperfective yields a habitual reading.

On this view, the VP denotes a set of events, to which singular and plural event operators can apply, returning sets of singular and plural events, respectively. These operators apply at the VP level below Asp, and are defined in (36):

(36) a. SG(⟨VP⟩) = {e₁, e₂, e₃, ...}
b. \( \text{PL}(\llbracket \text{VP} \rrbracket) = \{ e_1 \oplus e_2, e_2 \oplus e_3, e_1 \oplus e_3, e_1 \oplus e_2 \oplus e_3, \ldots \} \)

We can maintain the semantics for \( \text{di} \) following the denotation in (33), assuming that it applies not to \( \text{VP} \) directly, but to \( \text{VP} \) plus a singular or plural operator. When the singular operator applies, the event-in-progress reading obtains, as in (35).\(^{10}\) When the plural operator applies, the habitual reading obtains. Our analysis for the habitual sentence (19), repeated as (37), is given in (38):

(37) (Altine b-u nekk,) Fatou daf-a-Ø di (>dafay) rëdd ay wërëngërél.

Monday CM-C be, Fatou do-C-3SG IMPF draw INDEF.PL circle

‘(Every Monday,) Fatou draws circles.’

(38) \[ [\text{Faatu dafay rëdd ay wërëngërél}] = \lambda w. \exists e \exists t \llbracket t \subseteq \tau(e) \& \forall w' \in \text{BEST}(\text{CIRC}, \text{NI}, e) [\exists e' \exists t' \llbracket t \subset t' \& t' = \tau(e') \& \text{PL}(\text{draw}(f, c, e', w'))] \rrbracket \]

For such a habitual sentence to be true, a single \( P \)-event need not be ongoing at \( t \), but the run-time of a habit (a plurality of events) must be ongoing at \( t \).

5. Future readings of \( \text{di} \)

In this section, we seek to extend the analysis for event-in-progress and habitual readings of \( \text{di} \) to future readings. We first explore whether the semantics we already have is enough to account for these readings, and we will see that there are problems. We then consider the possibility that future readings (for high \( \text{di} \)) make use of a metaphysical modal base instead.

5.1. Circumstances are not enough

While futures are in general typically analyzed as involving modality, future readings are not usually taken to involve circumstantial modality, but something else: either metaphysical (see Condoravdi, 2002; Copley, 2002, 2008; Kaufmann, 2005) or epistemic (see Giannakidou and Mari, 2018).

There is, however, a variety of futures that might plausibly be analyzed as involving circumstantial modality. These are the futurate readings of the present tense (with Progressive or non-Progressive aspect) in English (Copley, 2002, 2008).

(39) The Red Sox \{play/are playing\} the Yankees tomorrow.

(40) #The Red Sox \{defeat/are defeating\} the Yankees tomorrow.

As Copley and others have pointed out, these readings require that some kind of plan or schedule be available in the context. (40) is thus odd since it suggests that the game is fixed.

\(^{10}\)Instead of the conjunct \( \text{draw}(sp, c, e', w') \) in (35), we have \( \text{sg}(\text{draw}(sp, c, e', w')) \).
Copley argues for a modal semantics of futurates that involves the following ingredients. First, such sentences (i) presuppose that there is some director $d$ who is able to “direct” the prejacent proposition $p$, and (ii) assert that $d$ is committed to bringing about that $p$ in the worlds quantified over. Copley argues that futurates involve a metaphysical modal base with a bouletic ordering source. However, it seems intuitively plausible that a circumstantial modal base with non-interruption ordering source could also get these facts. We have already seen in (29) that dispositions and abilities of the event participants can be part of the circumstances of an event from which a modal base can be projected for event-in-progress readings (and Ferreira (2016) shows this to be true for habituals as well). If we can include a plan for a future event as part of the circumstances that hold at the reference time, then in principle the semantics we have already developed for $di$ should be able to derive future readings as well.

The analysis for a sentence like (21), repeated here as (41), would look something along the lines of (42), where the event $e$ that is ongoing at the reference time is the planning event, and $e'$ is a temporal superevent that includes the planning event and the event of actually building the house.

(41) \[C\text{ONTEXT: I see Mbaye walking around the town with an architect, buying building materials, etc., and I ask our mutual friend what Mbaye is up to, and he tells me:} \]
Mbaye daf-a-θ di (> dafay) tabax kêr.
Mbaye do-C-3SG IMPF build house
‘Mbaye is going to build a house.’

(42) \[\lambda w. \exists e \exists t [t \subseteq \tau(e) \& \forall w' \in \text{BEST(CIRC, NI, } e) [\exists e' \exists t' \left( t \subset_{nf} t' \& t' = \tau(e') \right) \& \text{SG(build.a.house}(m, e', w'))]]\]

Such an analysis does seem on track for the examples we have collected so far where a future reading is available for low $di$. In (22), for instance (see section 3), the relevant circumstances would be the fact that the doctor has prescribed the medicine and that Fanta plans to take it.\footnote{A reviewer for SuB asks whether we have independent motivation for the idea that planning or preparatory events can be targeted by grammatical operators in Wolof. We have not yet been able to adduce such evidence from the data at our disposal.}

However, this analysis will not derive all the future readings available for sentences with $di$. In particular, there are several examples with high $di$ which seem to simply involve a prediction, and a relation to any planning event seems tenuous at best, for instance (24) and (26) in section 3. It would seem, then, that not all future readings for high $di$ can be accounted for using a circumstantial modal base.

5.2. Another modal base for future readings of high $di$

Following a Kratzerian view on modals (Kratzer, 1981, 2012), different modal flavors for one and the same modal is due not to ambiguity, but to the availability of different modal bases. Thus, epistemic and deontic $\textit{must}$ have the same lexical entry, but the different readings are due
to the availability of different sorts of modal bases (epistemic and circumstantial, respectively).
Since our semantics for *di* makes use of a modal base and ordering source, we can extend the idea of having different modal bases available for *di* as well.\(^{12}\)

Now, we have just seen that a circumstantial modal base won’t derive the future readings for (high) *di* that don’t seem to involve any sort of planning or preparatory event. Other authors have treated future readings as involving either metaphysical or epistemic modality. For Condoravdi (2002); Copley (2002, 2008); Kaufmann (2005) and others, futures involve a metaphysical modal base with inertial or bouletic ordering sources. For Giannakidou and Mari (2018), apparent ‘futures’ in Italian and Greek are always epistemic, but can receive their future temporal orientation from a non-past tense scoping under the modal.

In Wolof, we find that *di* cannot have an epistemic reading. In the context of (43), the modal *mên* is used instead.\(^{13}\)

\[
(43) \quad \text{[CONTEXT: Loulou and I are expecting our friend Magatte and someone knocks.]} \\
\text{a. } \#\text{Di-na-}0 \text{ nekk Magatte.} \\
\text{IMPF-C-3SG be Magatte} \text{intended: 'That will be Magatte.'}
\]

\[
\text{b. Mên-na-}0 \text{ nekk Magatte.} \\
\text{can-C-3SG be Magatte} \text{'That could be Magatte.'}
\]

In the absence of evidence for epistemic uses of *di*, we will stick to the more standard view that futures are metaphysical. We will follow the idea that a metaphysical modal base consists of the set of possible futures branching from an evaluation time \(t\) (Condoravdi, 2002; Kaufmann, 2005; Klecha, 2016). The future orientation of a metaphysical modal base is derived via the Diversity Condition (Condoravdi, 2002), which requires that a modal base contain worlds where the prejacent (embedded) proposition is true and worlds where the prejacent is false. This condition derives future temporal orientation, since the past is already ‘settled’. We take a metaphysical modal base to be anchored to world-time pairs, as in (44) (cf. Kush 2011; Klecha 2016).

\[
(44) \quad \text{METAPHYSICAL MODAL BASE:} \\
\bigcap \text{METAPH}(<w,t>) = \{w' \mid w' \text{ is identical to } w \text{ up to time } t\}
\]

We will assume a stereotypical inertial ordering source; cf. Copley (2002, 2008), where the ordering source for futures can also be bouletic. Putting these pieces together, a preliminary semantics for the future readings of (high) *di* can be modeled as in (45), where \(P\) is now a

\(^{12}\)Arregui et al. (2014) also make use of different types of modal bases to derive the variability in the interpretation of imperfectives in several languages.

\(^{13}\)Further examples of this kind should be tested. For instance, Winans (2016) shows that there are interpretational differences in English between the two types of epistemic statements using *will*:

(i) a. That will be the neighbors barbecuing.
   b. The neighbors will be barbecuing.
property of times. A preliminary analysis of (25), repeated below as (46), is then given in (47).

\begin{equation}
\text{(45) Preliminary proposal for future readings of } di:
\end{equation}

\[\text{[} \text{di}_{high} \text{]} = \lambda P_{(i,s,t)} \lambda t \lambda w. \forall w' \in \text{BEST(METAPH,STER,t,w)} [\exists t' > t[P(t',w')]]\]

\begin{equation}
\text{(46) Musaa } \text{di-na-}0 \text{ ñêw.}
\text{Moussa IMPF-C-3SG come}
\text{’Moussa will/is going to come.’}
\end{equation}

\begin{equation}
\text{(47) } \lambda w. \exists t \forall w' \in \text{BEST(METAPH,STER,t,w)} [\exists e \exists t' > t & t' \circ \tau(e) & \text{come}(m,e,w')]]\]

A couple of comments are in order before we continue. First, we assume that when \textit{di} takes a metaphysical modal base, the event variable is existentially closed. Second, we assume that the metaphysical readings for futures subsume the circumstantial ones, i.e., futures where there is a planning or preparatory event ongoing at the reference time are compatible with a metaphysical modal base as well, so we don’t rule out the compatibility of circumstantial futures with (45). Finally, we note that the future temporal profile of \textit{di} is derived in two different ways, comparing (45) with (33). We discuss this issue more in the next section, after detailing our proposal for connecting modal flavor with the syntactic position of \textit{di}.

6. Modal variability and syntactic height

Taking stock of where we have come, we have proposed that the different readings for \textit{di} are derived by different types of modal bases. The event-in-progress and habitual readings, as well as future readings involving a planning or preparatory event, are derived by a circumstantial modal base anchored to an event. The other future readings involve a metaphysical modal base anchored to a world-time pair. Recall as well that the availability of these readings depends on the syntactic position where \textit{di} appears in the clause. For low \textit{di}, the readings available are those derived from a circumstantial modal base. For high \textit{di}, the only reading available is the future reading, based on a metaphysical modal base. The remaining work, then, is to correlate the choice of modal base for \textit{di} with its syntactic position, which will in turn derive the desired readings for \textit{di} in the two positions.

The availability of certain readings depending on syntactic height is reminiscent of the generalization that epistemic and root modality correlate with modals occupying high and low positions, respectively (e.g., Cinque 1999; Hacquard 2006, 2010; Kush 2011). Under Hacquard’s analysis, low-scoping modals (below T) necessarily take a circumstantial modal base, and high-scoping modals (above T) necessarily take an epistemic modal base. We too derive the readings for low \textit{di} via a circumstantial modal base. If we follow Hacquard closely, the modal base would be \textit{epistemic} for high \textit{di}. We have already argued against having an epistemic modal base for high \textit{di}, and settled on a metaphysical modal base to derive the future readings of high \textit{di}.

We propose the following. Low \textit{di} is located in Asp, where only a circumstantial modal base is available. High \textit{di}, in contrast, moves to its high position via T, where it has access to a
metaphysical modal base. The structural aspect of our proposal is sketched in (48)-(49).

(48) CIRC modal base
    \[
    \begin{array}{c}
    \text{CP} \\
    \text{C} \quad \text{TP} \\
    \text{T} \quad \text{AspP} \\
    \quad \text{Asp} \quad \text{di} \\
    \end{array}
    \]

(49) METAPH modal base
    \[
    \begin{array}{c}
    \text{CP} \\
    \text{C} \quad \text{TP} \\
    \text{T} \quad \text{AspP} \\
    \quad \text{Asp} \quad \text{di} \\
    \end{array}
    \]

The mechanics of the proposal are as follows. The choice of modal base for \textit{di} not only correlates with syntactic height, but also with the semantic type of \textit{di}'s complement. When \textit{di} is in Asp, its complement (VP) is type \langle v, st \rangle. When \textit{di} is in T, its complement (AspP) is type \langle i, st \rangle. This type difference in turn determines the type of modal anchor available to derive the modal base. In Asp, the modal anchor available to \textit{di} is an event, which projects a circumstantial modal base (cf. Portner 1998; Hacquard 2010); in T, the modal anchor available to \textit{di} is a world-time pair, which projects a metaphysical modal base (cf. Kush 2011).

Our final proposal for the semantics of \textit{di} in its different positions is as follows in (50):

(50) When \(P\) is eventive:
    \[
    [\text{\textit{di}}_{\text{low}}] = \lambda \bar{P}_{(v, st)} \lambda \bar{t} \lambda \bar{w} \exists e[t \subseteq \tau(e) \land \forall w' \in \text{BEST}(\text{CIRC}, NI, w) [\exists e' \exists t'[t \subset_{n fin} t']] \\
    \& t' = \tau(e') \land P(e', w')] \]

When \(P\) is temporal:
    \[
    [\text{\textit{di}}_{\text{high}}] = \lambda \bar{P}_{(i, st)} \lambda \bar{t} \lambda \bar{w} \forall w' \in \text{BEST}(\text{METAPH}, \text{STER}, t, w) [\exists t' > t[P(t', w')]]
    \]

Although our analysis is disjunctive, the readings that are (un)available for \textit{di} are still derived in a systematic way. The lexical entries don’t make direct reference to the syntactic position of \textit{di}, but rather depend on the semantic type of its complement.\(^{14}\)

One issue that remains in deriving a truly unified analysis for all uses of \textit{di} lies in the temporal component. Although both entries for \textit{di} in (50) have a future-oriented temporal interpretation, the ways in which this is derived is different for high and low \textit{di}. For high \textit{di}, there is a direct future-shifting meaning incorporated into its semantics: there is a time \(t'\) in the future of the reference time \(t\) of the clause. For low \textit{di}, the future orientation is a bit more indirect. An event \(e'\) takes place over the interval \(t'\), which is a superinterval of the reference time \(t\). Since it is specified that \(t\) be a non-final subinterval of \(t'\), it follows that a part of \(t'\) continues into the future of \(t\). It is thus only the culmination of \(e'\) that is guaranteed to be in the future of \(t\).\(^{15}\)

\(^{14}\)If we assume a temporal variable located in the T head (cf. Bochnak and Martinović 2017), then given the tree in (49), the order of the first two arguments for \textit{di} when \(P\) is temporal should be reversed, with the semantic type for \textit{di} in this case being \(\langle i, \langle(i, st), st\rangle \rangle\).

\(^{15}\)Recall that in the case of circumstantial futures, \(e'\) includes preparatory stages ongoing at the reference time.
Given the connection we have proposed between the type of modal anchor and the semantic type of the modal operator’s complement (following Kush 2011), we can ask how an epistemic modal base would be derived in such a system. Kush (2011) proposes that an epistemic modal base is projected from a world anchor, which is available when a modal has a complement of type \(\langle s, t \rangle\), i.e., when a modal is located higher than \(T\). If this idea is on the right track, the natural question is why (high) \(di\) cannot take on an epistemic modal flavor, given that it appears in \(C\) after moving through \(T\) (see (16)), where it presumably has a complement of type \(\langle s, t \rangle\).

We make the following speculations. First, there could be a lexical specification in \(di\) that it cannot take an epistemic modal base. Although many modals (in English and other languages) can take a variety of modal bases to take on a variety of modal flavors, certain modals are lexically restricted to certain flavors. For example, the German modal \(dürfen\) is restricted to deontic interpretations in the indicative mood. So it could be that \(di\) is restricted to circumstantial and metaphysical modal bases. This would be a stipulation, but would rule out epistemic modal bases for \(di\). Second, it could be that something about the temporal/aspectual profile of \(di\) is incompatible with an epistemic modal base. For instance, certain authors have argued that there is no future epistemic readings for English \(must\) (Werner, 2006). However, Giannakidou and Mari (2018) argue for future epistemic readings in Greek and Italian, and Winans (2016) offers the following example as a future reading of epistemic \(must\) in English:

\[(51)\] John must leave tomorrow, the train only leaves once a month and it is tomorrow.

Thus, it is not clear that there is some deep incompatibility between futurity and epistemic modality that would independently rule out epistemic interpretations for \(di\). We leave a more principled investigation into why \(di\) cannot take on epistemic readings for future research.

Another remaining question has to do with the correlation of syntactic height and modal flavor. On our analysis, low \(di\) has the readings it does because it sits in Asp, and only has access to a circumstantial modal base projected from an event. Meanwhile, high \(di\) moves through \(T\) and receives its metaphysical modal base in that position. However, given the analysis in section 2 based on Martinović (2015), \(di\) continues to move up to \(C\). We have speculated why \(di\) cannot receive an epistemic modal base in the \(C\) position, but another question remains. If high \(di\) can pick up its modal base in \(T\) before moving on to \(C\), why can it not pick up a circumstantial modal base in Asp before moving on to \(T\) and \(C\)? In other words, what rules out the progressive and habitual readings for high \(di\) in our analysis? There are a couple directions one could take to address this question. First, there could be a general principle at work such that \(di\) must receive its modal base in the highest position possible, while independently ruling out taking on an epistemic modal base in \(C\). We know of no independent motivation for such an analysis. Second, perhaps \(di\) receives a metaphysical modal base in \(C\) after all, and not in \(T\). The mechanics of such an analysis remain to be worked out, but if a world-time pair anchor for a metaphysical modal base were available when \(di\) is in \(C\), then this would take care of at least part of this issue. For now, we must leave the spelling out of these suggestions for future research.

\[16\] Compare Hacquard (2010), where all modal bases are projected from events.
7. Conclusions

To sum up our analysis of the puzzle we introduced at the beginning, we correlate the available readings for Wolof \textit{di} with its syntactic height. For low \textit{di} in Asp, the modal base is anchored by an event, deriving a circumstantial modal base and Portner/Ferreira semantics for progressives and habituals, and circumstantial future readings. For high \textit{di} in T, the modal base is anchored by a world-time pair and is metaphysical, and only a future interpretation is derived. The choice of modal base depends on type of modal anchor, which depends on semantic type of \textit{di}'s complement.

Our analysis offers a new cross-linguistic perspective on the way modal height determines modal flavor via different types of modal anchors. We have departed from Hacquard (2010) in not claiming that all modal bases are projected from events, but the analysis we propose is along the same spirit, in that objects other than worlds can project a modal base. This case study from Wolof furthermore contributes to our understanding of the modal ingredients of aspectual operators, and more generally of the interactions between aspect, modality and temporality in natural language.

References


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Miners and modals
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Abstract. I generalise Kolodny and MacFarlane’s miners puzzle by showing epistemic analogues of their case exist. After motivating various conservative approaches to the original problem, I show how they fail to solve the problem in its epistemic guise. I argue that a probabilistic approach to information-sensitivity gives a general solution to the problem.

Keywords: deontic modals, miners puzzle, epistemic ‘should’, probability.

1. Introduction

Kolodny and MacFarlane introduced the infamous miners problem to the literature on deontic modals. I show that this semantic puzzle runs deeper than previously thought: there are epistemic analogues of Kolodny and MacFarlane’s case and they have a variety of upshots for our understanding of the problem.

After outlining the classic semantics and the problem it faces in section 1, I clarify what questions are at stake in section 2. Miners cases motivate not just a more expressive semantics but also the use of orderings based on measure-theoretic notions like expected utility and probability in our semantics for ‘ought’ and ‘should’. I show in section 3 that epistemic miners cases pose a major stumbling block for responses that try to avoid appealing either to information-sensitivity or measure-theoretic tools. Classic responses like Kratzer’s and Cariani, Kaufman, and Kaufman’s are geared explicitly towards the deontic case and do not generalise naturally. In section 4, I argue that information-sensitivity should be understood as a probabilistic phenomenon. I give an emendation of the classic semantics that can access probabilistic orderings and is sensitive to conditionalisation.

2. The problem

Take the following case from Kolodny and MacFarlane (2010):

Miners. Ten miners are trapped either in shaft A or in shaft B, but we do not know which. Flood waters threaten to flood the shafts. We have enough sandbags to block one shaft, but not both. If we block one shaft, all the water will go into the other shaft, killing any miners inside it. If we block neither shaft, both shafts will fill halfway with water, and just one miner, the lowest in the shaft, will be killed.

The following sentences seem true here:

(1) I ought to block neither shaft.

1Thanks to audiences at Sinn und Bedeutung 22 and the New York Philosophy of Language Workshop, three anonymous referees for Sinn und Bedeutung, Kai von Fintel, Milo Phillips-Brown, Ginger Schultheis, and, especially, Justin Khoo and Robert Stalnaker.
(2) If the miners are in shaft A, I ought to block shaft A.

(3) If the miners are in shaft B, I ought to block shaft B.

Surprisingly, it has been shown that the classic view of ‘ought’ and ‘should’ cannot predict the joint truth of (1) – (3).²

2.1. Information and the classical theory

The classic view, so-called in von Fintel (2012), assumes that ‘ought’ and ‘should’ are necessity modals:³ "ought $\phi$" is true just in case for any world $w$ in the modal’s domain $\phi$ is true at $w$. More precisely:

$$\text{ought } \phi^{c,i} = 1 \text{ iff } \forall w' \in \text{BEST}(i) : [\phi]^{c,i[w_i \rightarrow w']} = 1$$

This aspect of the classic view will not be under dispute here.

The classic view also says how the domain, $\text{BEST}(i)$, is determined. Following Kratzer,⁴ it is constrained by two ingredients, a modal base, $f$, and an ordering source, $g$. The modal base is a function from worlds to sets of propositions.⁶ These propositions represent the information we take to be held fixed in the background. The relevant body of information might be what a given agent knows, in which case the modal base is epistemic. Or it might simply be what is compatible with some relevant set of facts, in which case the modal base is circumstantial. On the classic theory, the role of the modal base is simply to restrict the domain of quantification: only worlds in the intersection of the modal base can feature in the domain of quantification.

The ordering source is used to construct an ordering on worlds. Its job is to represent, for each world, what the relevant priorities are. To do this, we let the ordering source be a function from worlds to sets of propositions, a function that, when given a world, yields us the set of priorities at that world. We generate an ordering from this as follows:

$$w_1 \leq_{w,f,g} w_2 \text{ iff } \{ p \in g(w) : w_1 \in p \} \supseteq \{ p \in g(w) : w_2 \in p \}$$

In other words, $w_1$ is at least as good as $w_2$ relative to $(w,f,g)$ just in case $w_1$ makes true all the propositions in $g(w)$ $w_2$ does and possibly more.

The domain of quantification of the modal is just the set of top $\leq$-ranked worlds compatible

²See, for instance, Charlow (2013), Cariani et al. (2013), Silk (2014).
³This semantics has been challenged by many: see, for instance, Lassiter (2011) and Cariani (2013). However, such challenges are orthogonal to the problem discussed here and so we can safely use the above semantics as our working theory.
⁴Here $i$ is a variable over indices and $i[w_i \rightarrow w']$ is the index formed by replacing the world in $i$ with $w'$.
⁶When it does not cause confusion, I sometimes use the term ‘modal base’ to pick out what is strictly speaking the intersection of modal base.
with the information in the modal base.\footnote{Here and throughout I make the limit assumption in stating the classic semantics.} In other worlds,

$$\BEST(w, f, g) = \{w \in \bigcap f(w) : \neg \exists w' \in \bigcap f(w) : w' <_{w,f,g} w\}$$

For us, the important feature of the classic semantics is that it rules out any interaction between these parameters: the ordering does not vary as we vary the modal base (but keep the other parameters fixed). In other words, on the classic semantics we have

\textbf{No \textit{f}-shifting}: For any modal bases \(f_1\) and \(f_2\), given a world \(w\) and ordering source \(g\), \(w_1 \leq_{w,f_1,g} w_2\) iff \(w_1 \leq_{w,f_2,g} w_2\).\footnote{It is straightforward to see that this holds on the classic semantics. While \(f\) is an argument for \(\leq\), it actually does not appear on the right-hand side of the definition. Hence, on the classic semantics it is a redundant argument. I include it as an argument to emphasise the point that the classic semantics does not allow the order to shift as the modal base changes.}

Given this principle, the only role for the modal base is to direct our attention to a certain portion of the ordering.

This is the crucial feature of the classic semantics: even as we add information to the modal base, the classic semantics will keep the background ordering on possibilities fixed.

2.2. The need for information-sensitivity

\textbf{Miners} challenges \textbf{No \textit{f}-shifting}: Kolodny and MacFarlane (2010) have argued that, on their deontic readings, adding information can change the relevant ordering for ‘ought’ and ‘should’. In particular, they think \textbf{Miners} shows that worlds can move up in the ordering as we add more information to the modal base.

To see why the classic semantics struggles here, we will need a theory of conditionals. I adopt throughout Kratzer’s restrictor theory of conditionals.\footnote{Kratzer (1991), Kratzer (2012).} On this theory, ‘if’-clauses restrict the domain of the modal in the consequent. More formally, where \(f + \phi\) is the modal base such that \(f + \phi(w) = f(w) \cup \{\phi\}\), we have:

\begin{equation}
[\text{if } \phi \text{ then } \text{MODAL } \psi]^{c,w,f,g} = 1 \iff [\text{MODAL } \psi]^{c,w,f+\phi,g} = 1
\end{equation}

Conditionals like (2) and (3) then have the following truth-conditions:

\begin{equation}
[\text{if } \phi \text{ then ought } \psi]^{c,w,f,g} = 1 \iff \forall w' \in \BEST(w,f + \phi,g) : [\psi]^{c,w',f+\phi,g} = 1
\end{equation}

So ‘if \(\phi\) then ought \(\psi\)’ will be true just in case all the best worlds which are \(\phi\)-worlds are also \(\psi\)-worlds.

\footnote{As Charlow (2013) shows, the problem still arises even if we adopt other theories of the conditional, such as those of Stalnaker (1968) and Lewis (1973).}
To see why Miners creates a problem, it will help to get some parameters on the table. I do not know the location of the miners, so $f(w)$ will contain worlds where they are in shaft A and worlds where they are in shaft B. Given that I have not made up my mind about what to do, the modal base will also contain worlds where I block shaft A, where I block shaft B and where I block neither. Since this is the only relevant information here, we can simplify and represent my knowledge with this set of worlds:

$$\bigcap f(w) = \{(A, blA), (A, blB), (A, blN), (B, blA), (B, blB), (B, blN)\}$$

We’ll take $g(w)$ to say that I should save as many miners as I can; or in other words,

$$g(w) = \{I \text{ save } 10 \text{ miners}, I \text{ save } 9 \text{ miners}, \ldots , I \text{ save } 1 \text{ miner}\}$$

Given these parameters, we can see that the best worlds will be ones where I block the correct shaft. So the ranking will be

$$\langle A, blA \rangle, \langle B, blB \rangle < \langle A, blN \rangle, \langle B, blN \rangle < \langle A, blB \rangle (B, blA)$$

This will give us the right predictions for (2) and (3). $BEST(w, f + A, g)$ will be $\{(A, blA)\}$. $BEST(w, f + B, g)$ will be $\{(B, blB)\}$. But we fail to predict the truth of (1). $BEST(w, f, g)$ will be a superset of $BEST(w, f + A, g)$, namely $\{(A, blA), (B, blB)\}$. In both of these worlds I block one of the shafts. This forces us to predict that (1) is false, the wrong prediction.

We can also consider what happens if we pick an ordering source which predicts the truth of (1). Suppose $BEST(w, f, g)$ is $\{(A, blN), (B, blN)\}$. This predicts that (1) is true: both worlds are ones where I block neither shaft. But now notice that $BEST(w, f, g)$ contains worlds where the miners are in A; so $BEST(w, f + A, g)$ will be $\{(A, blN)\}$. But then, (2) is false: all the best worlds where the miners are in A are worlds where I still block neither shaft. For similar reasons, we will predict (3) is false.

In either case, we have a problem: we cannot both keep the background ordering of worlds fixed and predict the truth of (1), (2) and (3). Kolodny and MacFarlane’s diagnosis is that, to make the right predictions, $BEST$ must be defined in such a way that makes it information-sensitive:

$$BEST \text{ is information-sensitive iff there exist } f_1, f_2 \text{ and } w \text{ such that:}$$

1. $\bigcap f_1(w) \supseteq \bigcap f_2(w)$
2. $BEST(w, f_1, g) \cap \bigcap f_2(w) \neq \emptyset$
3. $\exists w' : w' \in BEST(w, f_2, g) \& w' \notin BEST(w, f_1, g)$

---

$^{11}$It is shown in Cariani et al. (2013) how the problem arises for a circumstantial modal base. In fact, as we are about to see, the problem is independent of the particular choice of parameters.

$^{12}$I use italicisation to refer to propositions i.e. ‘$p$’ denotes the propositions that $p$.

$^{13}$From the results in Lewis (1981) we know there will have to be some such ordering source. But we will also see an example of an ordering source which makes similar predictions in section 3.1.
To see why the miners case seems to involve information-sensitivity, let us show that each condition appears to be met in Miners. Condition 1 follows from the set-up of the case and the restrictor semantics: we leave open possibilities where the miners are in A, so $\bigcap f(w) \supseteq \bigcap f + A(w)$. Condition 2 follows also from the set-up of the case: the best worlds, the ones where I block neither, include worlds where the miners are in A and worlds where they are in B. The crucial condition is condition 3. This condition is met just in case $BE(w, f + A, g)$ contains something that was not originally in $BE(w, f, g)$. And indeed, if (2) is true, then there must be such a world, $(A, bIA)$.

Information-sensitivity is incompatible with No-f-shifting. It is a consequence of No-f-shifting that, when there are $\phi$-worlds in $BE(w, f, g)$, then $BE(w, f + \phi, g)$ is $BE(w, f, g) \cap \phi$. That is, whenever we add a proposition $\phi$ to the modal base that is true some of the best worlds, the new best worlds are always the old ones where $\phi$ is true. Miners appears to be a counterexample: the conditionals add a new proposition to the modal base that is true in some of the best worlds; but the new set of best worlds in fact must be disjoint from the old one.

Thus it looks like we need some new way of defining $BE$ which allows the ordering to shift as we add information to the modal base. This is the semantic challenge of the miners case.

### 3. What is at stake

The literature has gone in different ways from this point, taking various morals from the case. I will try to carve out what seem to me the key questions here. In doing so, I will try to get clear on what reasons there might be to favour the various conservative impulses the literature has displayed.

#### 3.1. A pragmatic solution

The first, most straightforward question is whether we really need to add information-sensitivity to our semantics. When semantic explanations fail, it is natural to turn to pragmatics for an answer. By doing so, we might explain the judgments in Miners without altering the classic semantics. We’ll call a theory that tries to do without any information-sensitivity a very conservative theory.

Adding information-sensitivity has met with strong resistance in some quarters. For some, information-sensitivity is a deeply dubious property. Charlow (2013) for instance asks how

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14 In fact, something somewhat stronger will have to be true: $BE(w, f, g)$ and $BE(w, f + A, g)$ will have to be disjoint. However, the weaker principle, information-sensitivity, captures the main conceptual contrast with the classic semantics, the idea that possibilities get ranked higher as we get more information.

15 The semantic challenge is to be distinguished from what we might call the inferential challenge. As Kolodny and MacFarlane note, (1), (2) and (3) together give us a counterexample to modus ponens. This feature of the case will not concern us here. Moreover, as has been shown in Khoo (2013), our background theory of conditionals, the restrictor view, does not validate modus ponens anyway.

16 See, for instance, von Fintel (2012).
it could be possible that certain worlds get *better* as more information is added. But this reads too much into the semantics: even when the modal is deontic, our ordering need not represent how good worlds themselves are. Preference orderings can surely change as we get more information: which possibilities seem best to me can change as I gain more information.

That being said, resistance here *is* well-motivated, even if not by the reasons that have been given. Adding information-sensitivity would result in a theory more expressive than the classic theory. As well as the readings provided by the classic semantics, we now predict new possible interpretations of modals where shifting the modal base shifts the ordering. But we should prefer less expressive theories where possible: if we can postulate fewer possible readings and still capture the data, then that is what we should do. In this case, we should wonder if we can capture the appearance of information-sensitivity using some pragmatic mechanisms.

The main kind of very conservative response denies that (1), (2) and (3) are all evaluated within the same context. In particular, it claims that the ordering source used to evaluate (1), the ‘subjective’ ought, is different from that used to evaluated (2) and (3), the objective ‘ought’. As outlined in von Fintel (2012), such a strategy can successfully predict the judgements. Suppose the ordering source for (1) were

\[
g(2)(w) = \{ \text{If we know where the miners are, our chosen action yields the optimal outcome for the miners, If we do not know where the miners are, our chosen action yields a still acceptable outcome for the miners and would not yield a less acceptable outcome if they weren’t where they in fact are} \}
\]

We then get the result that (1) is true. If we suppose that the ordering source for (2) and (3) is

\[
g(2)(w) = \{ I save 10 miners, I save 9 miners, ... , I save 1 miner \}
\]

we predict true readings for both.

Context-shifting strategies are only as plausible as the claim that context might supply those parameters. But these particular parameters are plausible. There is a genuine difference between the subjective and the objective ‘ought’: the former tracks what we should do given what we know, and the latter tracks what would be best for us to do given all the facts. What’s more, it gives us an understanding of the case which is intuitively satisfying. This approach cannot be accused of dreaming up *ad hoc* parameters to solve the problem.

3.2. A non-probabilistic solution?

There is another aspect of the classic semantics at stake, even if we admit information-sensitivity. If ‘ought’ is information-sensitive, there is a serious question about where the information-
sensitivity comes from. MacFarlane and Kolodny give no clear guidance here — nothing in their system tells us anything about how it is to be generated. But our semantics should be predictive. Given a plausible story about the context, it should tell us why information-sensitivity comes into play in cases like miners.

The classic semantics gives us a very clear story about where our orderings come from: they are constructed out of sets of propositions by appeal to entailment. Something like this story might yet hold up, even if the classic semantics must be altered in other ways. This brings us to our second question: can miners cases be explained using only possible worlds machinery? This question is an important one about the structure of our theory of modal vocabulary and its relations to other important concepts. We’ll call a theory that answers no to this question a moderately conservative account.

It is striking that the judgements in the miners case track natural judgements about the expected utilities: blocking neither shaft has the highest expected utility; and conditional on the miners being in A, blocking A has the highest expected utility (and similarly for B). But such measure-theoretic notions carry far more information than measure-theoretic tools: they tell us not just how possibilities are ranked, but carry information about how much better certain possibilities are than others. Before allowing these kinds of structures to access our semantics for modals, we should want good reason to think they are needed.

A leading moderately conservative theory is that of Cariani et al. (2013). This semantics allows information-sensitivity but remains close to the spirit of the Kratzer framework in constructing its orderings. Cariani, Kaufman, and Kaufman (CKK from henceforth) add a decision problem to the Kratzer semantics, a set of propositions representing the actions available to an agent in a given scenario. For instance, in the miners case, the decision problem δ would be \{I block A, I block B, I block neither\}. What ends up being important is not just the decision problem but also the decision problem as restricted by the modal base. Such a restriction is obtained by intersecting each member of the decision problem with the modal base. In our example, the decision problem restricted by f would be \{I block A and the miners are either in A or B, I block B and the miners are either in A or B, I block neither and the miners are either in A or B\}.

Importantly, the relevant orderings on worlds, though information-sensitive, are still generated by means of entailment. An ordering is defined on the members of the restricted decision problem and used to create a corresponding ordering on worlds. A member of the decision problem p is at least as good as another q just in case p entails all the same ordering source propositions as q and maybe more. More precisely:

\[ p \preceq_{f,g,w} q \iff \{ r \in g(w) : p \subseteq r \} \supseteq \{ s \in g(w) : q \subseteq s \} \]

A world is then taken to be just as good as another as long as both p and q entail all the same ordering source propositions as q and maybe more. More precisely:

\[ \Delta_{f,g}(w) \preceq_{f,g,w} \Delta_{f,g}(w') \iff \Delta_{f,g}(w) \preceq_{f,g,w} \Delta_{f,g}(w') \]

Our clause for the modal is more or less as before:
where the $BEST$, like before, is:

$$BEST(w, f, g, \delta) = \{w \in f(w) : \neg \exists w' \in f(w) : w' < w, f, g, \delta w\}$$

## 4. Epistemic miners cases

I have shown that conservativity at each point is well-motivated. But now that we have built it up, I intend to knock it down. Both kinds of conservativity are insufficiently general. There are epistemic analogues of Miners and conservative solutions cannot account for them.

### 4.1. The case

So far we have seen only deontic ‘ought’s. But ‘ought’ can also be read *epistemically*. For example, suppose that Jane has been told the bus left 30 minutes ago and it usually takes 40 minutes to get to her bus stop. Jane might truly say

(5) The bus ought to arrive in 10 minutes.

This sentence says that it is probable, given Jane’s evidence, that the bus will arrive in 10 minutes. More generally, $\text{ought } \phi$ seems to communicate that $\phi$ is probable, given the relevant agent’s evidence.

Once we have isolated the epistemic ‘ought’, it becomes natural to ask whether it too is (apparently) information-sensitive. If so, then we should be able to generate cases analogous to Miners for the epistemic ‘ought’. In fact we can. Take the following case:

**Exam.** Alex and Billy are the top math students in their class and will take their weekly algebra exam tomorrow.

- Alex does best in 66% of the exams.
- Given that Billy studies tonight, Billy will probably get the best grade: out of exams he studied for, Billy did best in 66% of them.
- Given that Billy doesn’t study, Billy will certainly not do best. Alex did better in all of the exams that Billy didn’t study for.
- Billy always lets a fair coin toss decide whether he will study. He studies just in case it comes up heads.

Imagine we are asked who will do best and consider the following replies:
(6) Alex should do best.

(7) But, if turns out that Billy studied, then he should do best.

Both seem true here. The first seems true because, given what we know, it is more likely that Alex will do best. The second seems true because, were we to learn that the coin came up heads, we would think it more likely that Billy will do best.

Just as in Miners, the classic semantics cannot predict the truth of both (6) and (7). We can see that \( \text{BEST}(w, f, g) \) should both contain worlds where Billy studies and worlds where he doesn’t. After all, it’s neither likely that he will nor likely that he won’t.\(^\text{19}\) So \( \text{BEST}(w, f, g) \notin \text{Billy studies} \) and \( \text{BEST}(w, f, g) \notin \text{Billy doesn’t study} \). To predict (6), we need the set of best worlds to entail the proposition that Alex does best. So we want \( \text{BEST}(w, f, g) \subseteq \text{Alex does best} \). To predict (7), we want the set of best worlds which are worlds where Billy studies to be ones where Billy does best. In other words, we want \( \text{BEST}(w, f + \text{Billy studies}, g) \subseteq \text{Billy does best} \).

Suppose we have \( \text{BEST}(w, f, g) \subseteq \text{Alex does best} \), \( \text{BEST}(w, f, g) \notin \text{Billy studies} \) and \( \notin \text{Billy doesn’t study} \). This means that the updated modal base we use to evaluate (7) is consistent with \( \text{BEST}(w, f, g) \): as we said, \( \text{BEST}(w, f, g) \) neither entails that Billy studies nor that Billy doesn’t study. This means that \( \text{BEST}(w, f + \text{Billy studies}, g) \) must be a subset of \( \text{BEST}(w, f, g) \). But if \( \text{BEST}(w, f + \text{Billy studies}, g) \) is a subset of \( \text{BEST}(w, f, g) \), then \( \text{BEST}(w, f + \text{Billy studies}, g) \) also entails that Alex studies. We then fail to predict that (7) is true. So whenever \( \text{BEST}(w, f, g) \) contains both worlds where Billy studies and ones where he doesn’t, if we make (6) true, we are forced to make (7) false.

Information-sensitivity looks to be needed here too. Condition 1 is met because of the restrictor semantics: the modal base used to evaluate (7) is a subset of that used to evaluate (6). Condition 2 is met: \( \cap f + \text{Billy studies}(w) \) is consistent with \( \text{BEST}(w, f, g) \); in other words, the set of best worlds is consistent with the antecedent of (7). Finally, the third condition is satisfied. \( \text{BEST}(w, f, g) \) and \( \text{BEST}(w, f + \text{Billy studies}, g) \) must be disjoint. If (6) is true, then all worlds in \( \text{BEST}(w, f, g) \) are ones where Alex does best; if (7) is true, all worlds in \( \text{BEST}(w, f + \text{Billy studies}, g) \) are ones where Billy studies; and, of course, in no worlds do they both do best.

By running it through the classic semantics, we can see that Exam has the same problematic structure as Miners. We shall now see that unlike the original case, our epistemic miners case is also problematic for conservative solutions.

4.2. Against context-shifting

As we saw, the most natural very conservative strategy posits a context-change in Miners: the ordering source used to evaluate (1) is different to that used for (2) and (3). It will have to say

\[\text{What’s more, neither of the sentences}
(i) \quad \text{Billy should study.}
(ii) \quad \text{Billy should fail to study.}
\] has a true reading here.
something similar about Exam. The ordering source used to evaluate (6) (call it $g(6)$) is not that used to evaluate (7) (call it $g(7)$).

But notice that if $g(6)$ is available in the context, then we predict that it should be available to evaluate the conditional:

(8) (Even) if Billy studied, Alex should get the best results.

If this were the case, (8) should have a true reading. It would be heard to say:

(9) Even if Billy studied, it is still the case that, just given what we know now, Alex should get the best results.

But this is not the case: (8) has no true reading here. The context-shifting strategy thus overgenerates here: it predicts that, in addition to (7), we should also have a true reading of a conditional like (8). This is a bad prediction for the context-shifting view. Overgeneration is the hallmark of too much context-sensitivity.

The proponent of this strategy will have to say that, for some reason, the ordering source used to evaluate (6) is not available for (8). This is puzzling, particularly when (6) and (7) are uttered in sequence. They would be claiming the context shifts in such a way that, instead of giving (8) a true and non-trivial reading, it delivers instead a false reading of the sentence. None of the familiar mechanisms of context-change, such as accommodation in the sense of Lewis (1979), fit this profile. When context change happens, very often it does so to interpret a speaker charitably. Accordingly, it rarely changes to make utterances false. There is no obvious reason why the steadfast reading of (8) should be inaccessible.

Note that things get worse when we look back to Miners. Consider the following conditional:

(10) Even if the miners are in shaft A, I ought to block neither shaft.

This conditional is structurally analogous to (8); but unlike (8), this conditional is actually true here. This disparity poses an extra challenge for the very conservative theorist. Whatever way we try to explain the overgeneration here, we do not want it to carry over to the original miners case. As we noted, a steadfast reading is genuinely accessible there and so the context-shifting strategy must walk a fine line: its story must be strong enough to secure that there is no true reading of (8), but must not rule out a steadfast reading of (10). It is not clear how this could be done.

This issue does not put the same pressure on a non-conservative view. Unlike the context-shifting view, it is need not say that some available ordering source makes (8) true. It can posit an ordering source in Miners to make (10) true. But such a view is under no obligation to say the same thing for (8). This is a considerable advantage: when we posit just one ordering source to explain the truth of (6) and (7) we never open up the question of how we avoid predicting a true reading of (8).
4.3. Against moderate conservativity

**Exam** poses a separate and severe challenge for the approach in Cariani et al. (2013). Their account relies heavily on deontic features of the scenario in **Miners** to predict the consistency of the original miners sentences. But just this feature makes it hard to see how their theory can be adapted to the epistemic case.20

The first problem is how to interpret the decision problem parameter. Decision problems model the choices an agent must make in a given scenario; but in the scenario we outlined, there is no such choice at issue. In such a case, CKK say that the decision parameter should be set to the set of all worlds. This is designed to make the decision problem redundant, as they suppose the decision parameter will not be needed outside of deontic contexts. But naturally the decision problem for **Exam** must be non-trivial.

Probably the best way to generalise the view here is to think of the decision problem more generally as some salient partition of the modal base. In **Exam** we might let the decision problem be

\[(11) \quad \{\text{Alex does best}, \text{Billy does best}\}.\]

Even still, when we give the semantics plausible ordering sources, it does not make the right predictions.

Take a probability based ordering source:

\[(12) \quad g(w) = \{\phi: \phi \text{ is probable in } w.\}\]

To simplify things, suppose that the only things probable on our evidence are that Alex does best, that if Billy studies, Billy does best and that if Billy does not study, Alex does best. This gives us the following:

\[(13) \quad g(w) = \{\text{Alex does best}, \text{If Billy studies, Billy does best, If Billy doesn’t study, Alex does best}\}\]

To predict the truth of (6) we want this ordering on decision problem cells:

\[(14) \quad \text{Alex does best} < \text{Billy does best}.\]

Our current choice of ordering source delivers this. Only **Alex does best** entails any ordering source proposition (namely itself). To predict (7) we want a new ordering on decision problem cells:

---

20The solution in Charlow (2013) seems to face similar issues. For him information-sensitivity is generated by the interaction of two ordering sources, one tracking what is deontically best and another tracking what is actionable. Information-sensitivity is generated by the fact that, against different modal bases, different propositions will be actionable. Again, it’s not clear how to extend this idea to epistemic cases, as there is no obvious parallel for the actionable propositions.
(15) **Billy studies and Billy does best < Billy studies and Alex does best.**

But we do not get this. Grant that *Billy studies and Billy does best* entails the conditional *If Billy studies, Billy does best*. The proposition *Billy studies and Alex does best* also entails an ordering source proposition, namely *Alex does best*. Neither cell of the decision problem entails all the ordering source propositions of the other and more besides. This means that, rather than giving us (15), the two cells are *incomparable*.

The CKK approach yields information-sensitivity, but not in all of the right places. When we chose a plausible ordering source for *Exam*, one that tracks the probabilities of the case, refining the decision problem is not enough to get the change in ordering we need. Here too conservativity looks unpromising because it fails to generalise.

5. **A solution**

Cases like *Exam* are important evidence that information-sensitivity is more prevalent than previously thought. It appears not just in the deontic realm, but in the epistemic too. Conservatism fails because it is too narrow in scope. It cannot explain away information-sensitivity, as the very conservative theorist hopes. Nor can it be explained with possible worlds machinery alone, as the moderate conservative hopes.

If instead we account for information-sensitivity by appeal to probability, we do better. I will start by outlining a connection between the set of best worlds and probabilistic notions and show that if this connection were to hold, we would predict our data. Crucially, the role played by conditionalisation is what allows the orderings to shift. Then I will outline a semantics which delivers those principles and so predicts what we want in *Miners* and *Exam*.

5.1. **The role of probability**

I suggest that, in the relevant miners cases, we want our semantics to predict the following:

**Deontic:** \( \forall w' \in \text{BEST}(w, f, g) : [\phi]_{c,w',f,g} = 1 \iff \exists \psi : \text{EU}(\psi \cap f(w)) > \text{EU}(\phi \cap f(w)). \)

**Epistemic:** \( \forall w' \in \text{BEST}(w, f, g) : [\phi]_{c,w',f,g} = 1 \iff \text{for the contextually supplied threshold probability } \theta : P(\phi \cap f(w)) > \theta. \)

In each case, conditionalisation generates information-sensitivity. The expected utility of \( \phi \) might be overtaken by that of some other option entailing \( \neg \phi \) whenever we conditionalise on some other proposition \( \psi \). When the set of best worlds tracks expected utilities, updating the modal base with \( \psi \) will change the relevant best worlds: now they include \( \neg \phi \) worlds that were not there before. Similarly for probabilities: conditionalising on some proposition \( \psi \) may cause the probability of \( \phi \) to drop below the threshold and push that of \( \neg \phi \) above it. This will mean that updating the modal base with \( \psi \) will change the ordering on worlds: they will now include \( \neg \phi \) worlds that were not there before. So in each case, conditionalisation can lead to worlds
getting a higher position in the ordering.

Let’s now see this in action. Recall our sentences from Miners:

(1) I ought to block neither shaft.
(2) If the miners are in shaft A, I ought to block shaft A.
(3) If the miners are in shaft B, I ought to block shaft B.

We can fill in the details of the case to see how Deontic will give us the right results. The miners are just as likely to be in A as they are to be in B. Outcomes where I save more miners have higher utility than those where I save less. So let’s imagine that $P$ and $U$ are as follows:

\[
P(A) = P(B) = 0.5
\]

\[
U(A \land blA) = U(B \land blB) = 1
\]

\[
U(A \land blB) = U(B \land blA) = 0
\]

\[
U(A \land (\neg blA \land \neg blB)) = U(B \land (\neg blB \land \neg blA)) = 0.9
\]

When we conditionalize $P$ on $\neg (f(w))$, this will not change the probabilities above. When we do the expected utility calculations,$^{21}$ the resulting order on propositions is

\[block\ either < block\ A \equiv block\ B\]

Thus block neither has the highest expected utility and so, given Deontic we predict (1) to be true in this context.

When we conditionalise on $\neg (f + A(w))$, the probabilities change. The ordering on propositions shifts accordingly:$^{22}$

\[U(A \land blA) Pr(A) + U(B \land blA) Pr(B) =
\]

\[
1 \times (0.5) + 0 \times (0.5) = 0.5
\]

which will be the same as the value assigned to blB; whereas as the value assigned to ($\neg blA \land \neg blB$) will be

\[
U(A \land (\neg blA \land \neg blB)) Pr(A) + U(B \land (\neg blB \land \neg blA)) Pr(B) =
\]

\[
(0.9) \times (0.5) + (0.9) \times (0.5) = 0.9.
\]

$^{21}$We can see that conditionalising $P$ on $\neg (f(w))$ will make no difference to any of the values of $P$ which we have specified. So the value assigned to $blA$ will be

\[
U(A \land blA) Pr(A) + U(B \land blA) Pr(B) =
\]

\[
1 \times (0.5) + 0 \times (0.5) = 0.5
\]

$^{22}$Our new probabilities will be

\[
P(A) = 1
\]

\[
P(B) = 0
\]

Recalculating the expected utilities, the value assigned to ($\neg blA \land \neg blB$) will be equal to
block A < block neither < block B

block A now has the highest expected utility. Hence, given Deontic, when the modal base restricted to the worlds where the miners are in A, all the worlds in $BEST(w, f + A, g)$ will be ones where we block shaft A. Given the restrictor view of conditionals, it follows that (2) is true here. By similar reasoning, we also predict the truth of (3).

Let’s turn now to Exam to see how Epistemic predicts the right results there. Our sentences there were:

(6) Alex should do best.
(7) But, if turns out that Billy studied, then he should do best.

Given the set up, the probabilities should be

$$P(Alex\ does\ best) = 0.66$$
$$P(Billy\ does\ best) = 0.33$$
$$P(Alex\ does\ best \mid Billy\ studies) = 0.33$$
$$P(Billy\ does\ best \mid Billy\ studies) = 0.66$$

Suppose now that the threshold probability is 0.5. Conditionalising on $\cap f(w)$ here will make no difference to the probabilities assigned to the above propositions. Hence, the proposition that Alex does best will pass the threshold and, by Epistemic, the best worlds will be ones where Alex does best. Hence (6) will be true.

When we conditionalise on $\cap (f(w) + Billy\ studies)$, the probabilities do change. In fact the probabilities of Alex does best and Billy does best are now equal to the conditional probabilities given above and the proposition Billy does best will now pass the 0.5 threshold. So, relative to our more restricted modal base $f(w) + Billy\ studies$, Epistemic tells us that all the best worlds are ones where Billy does best. Given the restrictor analysis of conditionals, we then predict that (7) is true in this context.

\[
\begin{align*}
U(A \land (\neg blA \land \neg blB)) Pr'(A) + U(B \land (\neg blB \land \neg blA)) Pr'(B) &= \\
(0.9) \cdot 1 + (0.9) \cdot 0 &= 0.9.
\end{align*}
\]

but the value assigned to $blA$ will be

\[
U(A \land blA) Pr'(A) + U(B \land blA) Pr'(B) = \\
1.1 + 0.0 = 1.
\]

The value assigned to block B will

\[
U(A \land block B) P(A) + U(B \land block B) P(B) = \\
0.1 + 1.0 = 0.
\]
5.2. Implementation

We’ve seen that allowing probabilities into our semantics gives us a good general picture of where information-sensitivity comes from. Now I outline a more general definition of BEST that, when combined with a plausible selection of parameters supplied by context, delivers the desired connection.

Earlier we entertained the question of whether all the necessary orderings for modal semantics can be generated using just propositions. If we want probability to play a serious role, this will be difficult to maintain. Probabilistic notions are notoriously difficult to recover from purely qualitative information. As shown in Lassiter (2015), attempts to do so (like that in Kratzer (1981)), tend to have undesirable logical properties: for instance, Kratzer’s approach predicts that whenever $\phi$ is as likely as $\psi$ and as $\chi$, it is as likely as $\psi \vee \chi$; but probabilistic orderings do not in general have this property. Thus, if probability is to be used in our semantics for ‘ought’, it is hard to see how it could be moderately conservative in the sense that we outlined earlier.

We will make the classic semantics more flexible so that it can access the kinds of orderings we need. We keep the modal base parameter without any changes: it is still a function from worlds to propositions and intuitively represents the information we are holding fixed. However, we change how ordering sources work. Firstly, we want ordering sources to have, among other things, modal bases as arguments: this is essential to any solution that allows information to shift the relevant ordering. Secondly, we want to allow ordering sources to exploit orders on propositions. The final ordering on worlds should track an expected utility ordering in the deontic case and a probability ordering in the epistemic case. We modify our definition of an ordering source accordingly: now an ordering source $g$ is a function from a world and a modal base to an ordering $\preceq_{w,f,g}$ on propositions.

In the deontic case, the ordering will straightforwardly track the relevant expected utility ordering. That is we will have

$$\phi \preceq_{w,f,g} \psi \text{ just in case } EU(\phi|\cap f(w)) \geq EU(\psi|\cap f(w)).$$

In the epistemic case, we want the ordering to reflect whether or not a proposition passes a contextually supplied threshold. That is, we want it to be the case that no proposition is strictly better than $\phi$ whenever the probability of $\phi$ passes the given threshold. To secure this, we will define the ordering as follows:

$$\phi \preceq_{w,f,g} \psi \text{ iff, where $\theta_\epsilon$ is the contextually determined threshold, one of the following conditions holds:}$$

1. $P(\phi|\cap f(w)) > \theta_\epsilon$; or

23One exception to this is the semantics in Holliday and Icard (2013); but as Lassiter (2015) points out, that semantics will have issues validating entailments between probabilistic ‘should’ and other epistemic auxiliaries.

24As such, it is not distinctive of the approach pursued here: other information-sensitive solutions such as those in Cariani et al. (2013), Silk (2014) and Carr (2015) also suggest this move.
The first clause helps deliver the constraint we outlined. For once \( \phi \) passes the relevant threshold no other proposition will be strictly better than it.

We have an ordering on propositions and our aim now is to define \( BEST \) from this ordering. We will form \( BEST(w, f, g) \) by simply taking the \( \leq_{w, f, g} \)-best propositions consistent with the modal base and intersecting them. More formally, letting the set of best propositions be

\[
P_{BEST}(w, f, g) = \{ p \subseteq \bigcap f(w) : \neg \exists q \subseteq \bigcap f(w) : q \leq_{w, f, g} p \}
\]

we then say that

\[
BEST(w, f, g) = \bigcap P_{BEST}(w, f, g)
\]

That is, the domain for ‘ought’ is the intersection of the best propositions.\(^{25}\)

This will predict Deontic, given plausible assumptions. In Miners, it is plausible that we are deciding based on the expected utilities of the various options. Conditional on only the information in the modal base, blocking neither shaft has the unique best expected utility. In that case, \textit{we block neither shaft} is the unique best proposition and so the set of best worlds is simply the worlds in the modal base where we block neither shaft. But once we add to the modal base the proposition that the miners are in shaft A, \textit{we block shaft A} is the unique best proposition and so all the best worlds are ones where we block shaft A.

We also predict Epistemic, given plausible assumptions. Suppose again that the threshold is 0.5. The proposition that Alex gets the best results has 0.66 probability and so will be one of the best propositions. \( BEST(w, f, g) \), being the intersection of \( P_{BEST}(w, f, g) \) and \( \bigcap f(w) \) will contain only worlds where Alex gets the best results. Moreover, when we add to the modal base the proposition that Billy studied, then \textit{Billy gets the best results} will be among the best propositions and so, given our semantics, all the best worlds will be ones where Billy gets the best results.

\(^{25}\)In fact, this semantics is only really a first pass, as it will deliver the wrong results in cases where the set of best propositions is inconsistent. What we need is a generalisation of the intersecting method for cases like these.

Here is one way to generalise it. We still construct \( BEST \) from \( P_{BEST} \) but this time the procedure is somewhat more complicated. First, say that a maximal consistent intersection \( S \) of \( P_{BEST} \) is a set \( S \) that has the following properties:

1. \( S \) is the intersection of some members \( S_1, \ldots, S_n \) of \( P_{BEST} \)
2. The result of intersecting \( S \) with any further members of \( P_{BEST} \) results in the empty set.

In other words, we form a maximal consistent intersection of \( P_{BEST} \) by intersecting as many propositions in \( P_{BEST} \) as we can before getting the empty set.

We then form \( BEST \) by forming the union of the maximal consistent intersections of \( P_{BEST} \):

\[
BEST(w, f, g) = \bigcup \{ S : S \text{ is a maximal consistent intersection of elements of elements of } P_{BEST}(w, f, g) \}
\]
6. Conclusion

The problem raised by Kolodny and MacFarlane’s case runs deeper than previously thought. Miners cases arise not just in the deontic realm, but also in the epistemic realm. This has important ramifications for the ensuing debate. Conservativity, while well-motivated and plausible for the original cases, fails to generalise. This failure, I have argued, should lead us to see miners cases not as a deontic phenomenon, but as a probabilistic one. The classic semantics, in its original form, cannot accommodate this. But I have shown that, by dropping certain assumptions about how orderings are generated, we get a more flexible theory that can give a properly general solution to the miners problem.

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Children’s comprehension of pronouns and definites.¹
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Abstract. We present an experiment which tests children’s comprehension of the requirements of use of pronouns and definites. An adult-like use of definites and pronouns imposes different but related requirements. In the case of definites, a unique referent is required in the context, whereas in the case of a pronoun, the referent in the context has to be salient. In this experiment, we use a novel word task to test three-year-olds’ sensitivity to these requirements. Our results show that children are adult-like in their sensitivity to salience in their comprehension of pronouns, compared to definites. However, they failed to show sensitivity to the uniqueness requirement on the use of definites.

Keywords: pronouns, definiteness, language acquisition, salience, uniqueness, familiarity.

1. Introduction

In this paper, we present an experiment on children’s comprehension of the requirements of use of pronouns and definites. An adult-like use of the definite article and pronouns imposes different but related requirements. In the case of the definite article, a unique referent is required in the context (see e.g., Heim and Kratzer, 1998; Elbourne, 2005, 2013). For example, in (1), there should only be one doll in the context. If there were two dolls, the indefinite article should be used. In the case of a pronoun, the referent in the context has to be salient (see e.g., Roberts, 2003): if no object were salient in the discourse of (2), the addressee would likely not know how to obey the command. In this experiment, we use a novel word task to test three-year-olds’ sensitivity to these requirements.

(1) Put the doll in the suitcase!
(2) Put it in the suitcase!

A mature understanding of what it means for an expression to be context sensitive is necessary for children’s acquisition of pronouns and definites. More specifically, children have to be aware that conversations follow certain rules and goals, e.g., that an utterance serves the goal of adding information to the commonly shared pool of information, the Common Ground (cf. Stalnaker, 1978). Related to this is the distinction between given and new information, such that given information is attributed to information within the Common Ground, while new information seeks to expand the Common Ground further. In the comprehension of definites and pronouns, children have to be able to track given information, because both constructions

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can only access referents in the discourse that have already been introduced and which have been identified as unique or salient, respectively.

Another important fact about language which children have to be aware of when hearing a pronoun or an article is that language is referential, i.e., that their task is to link the utterance to specific individuals within their discourse context. Which individual is mapped to which pronoun differs from context to context. Research on these pragmatic prerequisites has found that from a very early age on, and sometimes even in the preverbal period of language development, children are already sensitive to the purposes of communication. Roughly, children ages one or two demonstrate sensitivity to the goals within a conversation, the common ground, to given and new information and the distinction thereof, and to the interpretation of referring expressions (see for more detail Clark, 2016 and references therein). However, it remains less clear how and when children distinguish between different ways of referring to entities in the context, such as using a pronoun instead of a definite, i.e., picking the salient versus the unique referent, or an indefinite instead of the definite. Here we aim at giving first answers to these questions. We test three-year-olds’ comprehension of pronouns and definites via a selection task, using novel words. Because the unfamiliar objects are described using unfamiliar labels, the only information children can use to identify the right object are the cues coming from the use of a pronoun or definite or indefinite in different contextual situations, where a toy is unique or salient or both. Our results show that children are sensitive to the salience requirement of pronouns, but they may still struggle with the uniqueness requirement of definites.

In the following, we will delve deeper into the theoretical background regarding the contextual requirements on pronouns and definites in Section 2.1 to 2.3 and introduce previous work on the constructions and their contextual requirements in Section 2.4. We introduce the experiment in Section 3 and conclude in Section 4.

2. Theoretical Background

2.1. Definite Article: Uniqueness

The definite article ‘the’ has been associated with triggering a presupposition of uniqueness, meaning that its interpretation can only be defined if there is exactly one unique referent in the context that has the characteristics specified by the NP complement (see e.g., Heim and Kratzer, 1998; Elbourne, 2013; Roberts, 2003).

(3) # The semanticist gave a talk at Sinn und Bedeutung 22.
(4) A semanticist gave a talk at Sinn und Bedeutung 22.

In the examples above, the DP ‘the semanticist’ fails to refer to one unique referent in the context, as there were more semanticists present at the Sinn und Bedeutung 22 conference. The indefinite article is not associated with a uniqueness condition and using it in the same context is natural. The dominant view to explain the infelicity of (3) is to assume that when a definite article is used, the DP, and thus also the complete sentence, is only well-formed if there is only one uniquely available semanticist. If there were two or none, the sentence would
not be false, it would just be inappropriate. A standard formal definition of ‘the’ including the presupposition of uniqueness can be seen below.

\[ \text{[the]}^{g,c} = \lambda f_{<e,t>}: \exists! x[f(x) = 1].\forall x[f(x) = 1] \]

2.2. Pronouns: Salience

Elbourne (2005, 2013) argues that third person pronouns are interpreted in parallel to the definite article, i.e., they equally evoke a uniqueness condition on a contextually determined referent. The difference between definites and pronouns, according to Elbourne, lies in the NP complement: with pronouns, the NP complement is covert and contextually determined. For example, in (6) below, ‘it’ in the second sentence refers to the unique cat in the context. ‘The cat’ in the first sentence and ‘it’ in the second end up having the same interpretation, but in the latter case, the NP ‘cat’ is phonologically covert. ‘It’ under this analysis would thus be analysed as ‘the’ in (5) above.

(6)  *The cat is sleeping. It cat snores.*

Roberts (2003) proposes a refinement of Elbourne’s account, focussing on the specific contextual requirements associated with third person pronouns and the definite article, respectively: third person pronouns trigger a presupposition of salience entailing uniqueness, while the definite article triggers the classically assumed presupposition of uniqueness. She discusses the following examples originally introduced by Heim (1982):

(7)  I dropped ten marbles and found all of them, except for one.
    (a)  It is probably under the sofa.
    (b)  # The marble is probably under the sofa.

(8)  I dropped ten marbles and found only nine of them.
    (a)  ?? It is probably under the sofa.
    (b)  # The marble is probably under the sofa.
    (examples adapted from Roberts, 2003: 335)

(9)  A woman entered from stage left. Another woman entered from stage right.
    (a)  #The woman / The FIRST woman / The SECOND woman was carrying a basket of flowers.
    (b)  She was carrying a basket of flowers, while #the woman/ the FIRST woman/ #the SECOND woman led a goat.
    (examples from Roberts, 2003: 324)

In (7), the missing marble is made sufficiently salient, so that referring to it with the pronoun ‘it’ is natural, even though there are more marbles in the context. Using an underspecified definite NP ‘the marble’ violates uniqueness. In contrast, in (8), the missing marble is not sufficiently
salient, so that using ‘it’ to refer to it seems inappropriate, while using an underspecified definite NP is equally inappropriate as in (7). The only difference between (7) and (8) is the explicit mention of the missing marble. Example (9) highlights a similar point; the pronoun ‘she’ in (9b) can only refer to the last introduced woman, so the more salient one. This becomes evident by looking at the continuations of the sentence. Using an underspecified DP ‘the woman’ is still inappropriate, because the uniqueness requirement of the definite article is not satisfied by salience. Roberts (2003) takes these examples as a case in point that the definite article is not sensitive to salient discourse referents, but that third person pronouns are. Roberts’ formal analysis assumes the same lexical entry for ‘the’ as in (5) and the following lexical entry for pronouns (see (10)).

\[
\begin{align*}
\llbracket & \text{it} \rrbracket = \lambda f_{<e,t>} : \exists x[f(x) = 1 \& \text{SALIENT}(x) \& \forall y[\text{SALIENT}(y) \rightarrow y \leq_{\text{SAL}} x]] \\
& \text{SALIENT} \rrbracket_c = \lambda x. x \text{ is among the salient discourse referents in context } c \\
\end{align*}
\]

The ordering \( \leq_{\text{SAL}} \): For all \( a, b \) that are discourse referents in \( c \): \( a \leq_{\text{SAL}} b \) if (a) \( b \) is strongly familiar and \( a \) is weakly familiar, (b) \( b \) pertains to a more immediate Question under Discussion (QUD) than \( a \), (c) \( b \) is more prominent than \( a \) regarding grammatical relations such as topic/focushood etc. (adapted from Roberts, 2003: 334)

We will assume Roberts’ (2003) analysis for pronouns and the definite article for the purposes of this paper.

2.3. Familiarity

Let us briefly discuss one further contextual requirement that has been identified for definites, specifically in its comparison with indefinites. Most famously, Heim (1982) argues that the definite article should be associated with familiarity, i.e., that the referent of definites has to be already established in the previous discourse. This is different for indefinites, where the referent can be newly introduced into the discourse. Heim gives examples that demonstrate the adequacy of the novelty/familiarity distinction: In (13), the first sentence with the indefinite NP ‘a wine glass’ introduces a new referent in the discourse that can then be taken as a referent for the definite article in the second sentence ‘the glass’. However, if we try to use the indefinite article in order to refer to this already introduced wine glass, we get an inappropriate utterance; ‘A glass’ in (14) can’t refer to the previously introduced wine glass (for more details regarding the familiarity constraint on definites, see Roberts, 2003).

\[
\begin{align*}
(13) & \text{A wine glass broke last night. The glass had been very expensive.} \\
(14) & \text{A wine glass broke last night. # A glass had been very expensive.} \\
& \text{(examples from Roberts, 2003: 296)}
\end{align*}
\]

Familiarity applies to both definites and pronouns. In (15) below, the pronoun ‘it’ can be used in the second sentence to refer back to the wine glass introduced by the indefinite in the first sentence, just like the definite in (13).
(15) A wine glass broke last night. It had been very expensive.

To sum up, the contextual requirement of familiarity differentiates definites and pronouns from indefinites. The uniqueness and salience conditions differentiate definites from pronouns: definites require their referent to be unique, but not necessarily salient, while for third person pronouns, it is the other way around: their referent has to be salient, but not necessarily unique. Rather, it is unique by virtue of being the most salient referent in the discourse. In this paper, we will focus on the latter two requirements and ask if three-year-olds are aware of definites’ uniqueness requirement and third person pronouns’ salience requirement.

2.4. Previous Work

Previous studies have looked at pronouns and definites separately. For pronouns, it has been observed that children start producing pronouns very early on and roughly seem to understand them by two years of age (see e.g., Cruttenden, 1977; Shipley and Shipley, 1969; Chiat, 1981; Huxley, 1970; Halliday, 1975; Charney, 1980; Loveland, 1984; Moyer et al., 2015).

Song and Fisher (2003) tested whether children demonstrate sensitivity to discourse prominence in their interpretation of pronouns in a series of four experiments. Three-year-olds listened to a story accompanied by two screens simultaneously showing pictures of two discourse referents. In the story, the two discourse referents were mentioned equally often; however, only one of them was made prominent. A pronoun in the target sentence either referred to the prominent referent or to the other referent. Experiment 1 tested elicited imitation, and Experiments 2 to 4 tested preferential looking by measuring children’s fixation on the correct discourse referent. Results confirm that three-year-olds look at the prominent discourse referent right away when hearing a pronoun, while only later switching to the new referent in contexts. Adult controls confirm these results. However, the design in Song and Fisher (2003) leaves open the possibility that children do not really understand the salience requirement of the pronoun, but that they look at the protagonist of the story only because their attention was first drawn to the protagonist, no matter which requirements guide the interpretation of the pronoun. In our study we will test children’s understanding of the salience requirement of pronouns further in ways that avoid this possible confound.

For definites, studies report considerable flexibility in the production and comprehension of the definite article compared to the indefinite article: children seem to be overly permissive of using and accepting definites in contexts where they should be unavailable because their uniqueness presupposition is not satisfied (cf. Karmiloff-Smith, 1979; Schaeffer and Matthewson, 2005; Schafer and de Villiers, 2000; van Hout et al., 2010). Importantly, children’s difficulty mostly arises in cases where they are expected to use indefinites as opposed to definites.

\footnote{Control target items included a definite NP that referred to the referent in question. Note, however, that the presence of the NP argument of the definite article prevents us to conclude anything for the influence of prominence on the definite article per se.}
Van Hout et al. (2010) report on two experiments of children’s production and comprehension of the definite versus indefinite article at the age of 3;1 to 5;8. In the comprehension task, truth value judgments were elicited by showing children a sequence of two pictures where, in the first picture, a unique referent is singled out (i.e., the picture shows a baby with her father, holding one balloon, standing next to another person holding several balloons). In the second picture one of the balloons in the background, i.e., a new referent, flies away. Then, children were asked a question either including a definite or indefinite article (i.e., ‘Did the balloon/a balloon fly away?’). The target answer should be negative when the definite article is used, as the old referent, i.e., the balloon in the dad’s hand, doesn’t fly away. In parallel, the answer should be positive when the indefinite article is used, as indeed the new referent flies away. Children give a positive answer when the indefinite article is used, but also when the definite article is used, even though it is not the familiar, old referent which flies away. Adults answered mostly target-like. The results of the production study match these results. Overall, children seem over-permissive with definites: they tend to accept sentences with definites referring to a non-familiar referent. A possible confounding factor in this experiment is that the mere depiction of the flying balloon is sufficient to make it familiar: children zoom in on that part of the scene. Furthermore, a limitation of a truth value judgment task like this one is that children may want to be charitable and accept a description that is not completely appropriate to make the sentence true. In our study, we will use a selection task instead, to probe children’s sensitivity to the uniqueness requirement of definites: if children are sensitive to this requirement, the use of a definite should lead them to pick a unique object, in contrast to an indefinite.

To sum up, we see that children seem to understand the conditions of use of pronouns early on: they understand that third person pronouns refer to a discourse salient entity as early as age three. On the other hand, children seem to struggle with the conditions of use of the definite article vs. the indefinite article up to seven years of age. In our experiment, we further probe children’s comprehension of pronouns and definites and contextual requirements of these within a single experiment, using a simple selection task, incorporating novel words and novel objects. We ask whether (i) children are sensitive to salience when encountering a pronoun vs. a definite or an indefinite, and (ii) children are sensitive to uniqueness when encountering a definite vs. a pronoun or an indefinite.

3. The Experiment

3.1. The Task

As the focus of this experiment is on children’s understanding of the contextual requirements associated with definites and pronouns, our goal was to test this within the same task, by manipulating salience and uniqueness. As a control condition, we also included indefinites. In previous work, the comparison between definites and indefinites has proven to be difficult for children. We used a selection task using novel words to label unfamiliar objects, to get children to use information provided by the use of the construction (pronoun vs. definite vs. indefinite) to select the right object. Indeed, with a novel word, children cannot make inferences based on the meaning of the NP complement: they need to base their inferences on the articles or pronouns used in a given context.
3.2. The Design

Children are presented with three unfamiliar objects (pictures of objects unlikely to be familiar
to children, e.g., a tube cutter, a bagpipe, or an exotic fruit) as toys. One of the toys is different
from the other two. This setting establishes uniqueness in the case of the one unique object.
Then, the experimenter draws attention to either the unique object, one of the non-unique ob-
jects, or none of the objects. This way, we capture salience.

Specifically, the experiment is set up as a game (see Figure 1): Froggy is visiting his grand-
mother but has forgotten to bring toys. So the experimenter asks the child if they should pack
a suitcase for Froggy together. In order to find out which toys Froggy wants, the experimenter
and the child Skype with Froggy. The experimenter displays three cards with pictures of un-
familiar objects, Froggy’s toys, and draws attention to one of the toys. Then, Froggy gives his
clue in the form of a sentence like the following. After this, the child picks one of the three toys
and puts it in the suitcase.

(16) Pack the blicket in the suitcase!
(17) Pack a blicket in the suitcase!
(18) Pack it in the suitcase!

The Skype session is a video of Froggy that the experimenter pauses while interacting with the
child. In order to give the impression that Froggy is taking an active part in the conversation,
experimenter and Froggy exchange some introductory remarks at the beginning. We tested
children in a between-subjects design, separating participants into two groups. Group 1 heard
either the definite or indefinite article; Group 2 heard the definite article or the pronoun ‘it’.

In examples (19) to (21), we provide some sample target interactions within Group 1, com-
paring the definite and the indefinite article. We include three context conditions, alternating
which toy the experimenter pays special attention to:
(19) Context 1: No Extra Attention
Experimenter: [experimenter doesn’t point to any toy] Froggy, which toy do you want us to pack?
Froggy: Pack {the blicket/ a blicket} in the suitcase.

(20) Context 2: Attention to Unique Toy
Experimenter: [experimenter points to the unique toy] Oh, look at this one! I really like its color, it’s red! Froggy, which toy do you want us to pack?
Froggy: Pack {the gorp/ a gorp} in the suitcase.

(21) Context 3: Attention to Non-Unique Toy
Experimenter: [experimenter points to one of the non-unique toys] Oh, look at this one! I really like its shape, it’s funny! Froggy, which toy do you want us to pack?
Froggy: Pack {the glark/ a glark} in the suitcase.

The same context conditions were used for the second group, but Froggy would use either definites or the pronoun ‘it’ (see (22) below).

(22) {No Extra Attention/ Attention to Unique Toy/ Attention to Non-Unique Toy}
Froggy: Pack {the blicket/ it} in the suitcase.

In Table 1, we summarize how the design of the study reflects the theoretically derived contextual requirements. In the first context, where none of the toys is singled out by the experimenter, only uniqueness is given, as the visual setting singles out one of the toys. In the second context, the experimenter draws attention to the unique toy: here, both uniqueness and salience are given and target the same toy. In the third context, the experimenter draws attention to one of the two non-unique toys. Thus, uniqueness and salience are in competition: while the experimenter establishes a non-unique toy as salient, the pure visual context provides a different toy that meets the uniqueness requirement.

<table>
<thead>
<tr>
<th></th>
<th>Uniqueness</th>
<th>Salience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Context 1: No Extra Attention</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Context 2: Attention to Unique Toy</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Context 3: Attention to Non-Unique Toy</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

Table 1: Contextual Requirements as met in the Experiment

3.3. Methods

To make sure that children are able to perform the task in general, we included four trials where the toys presented were familiar, using familiar labels. For the actual experimental trials, we included four trials per condition with a 2x3 design, with two construction conditions (definite/indefinite article or definite article/pronoun) and three context conditions (no attention, attention to unique toy, attention to non-unique toy). We also included 4 control trials where Froggy wants the child to pick a toy without giving a clue. These control trials checked whether
children would pick toys by preference of location only, e.g., if they would always pick the rightmost toy. The order of trials was pseudo-randomized and was the same for all participants. Our measure for the statistical analysis was the percentage to which children would pick the unique toy.

3.4. Subjects

We tested 38 participants, 13 participants in group 1 (7 female, 6 male), 15 participants for group 2 (8 female, 7 male); 10 participants were excluded because they did not finish the study. All participants were between 2;11 and 3;11 years old (mean age: 3;4) and were tested in the Project of Children’s Language Learning at the University of Maryland. They were all native speakers of English. In addition, we tested an adult control group with the same material and setup. These were all native speakers of English. 6 participants were tested at the University of Maryland and 18 participants were tested at the University of Tübingen. Participants from each location were distributed evenly over the two groups. The age range of adults was 19 to 37 years with a mean age of 22 years. Female/male ratio was 1:1.

3.5. Predictions

3.5.1. Group 1: Definites vs. Indefinites

Our measure as a basis for the statistical analysis is the selection of the unique toy. If children have an adult-like understanding of the uniqueness requirement of definites, we expect that they should pick the unique toy whenever the definite article is used, irrespective of which toy is being made salient. Regarding the indefinite article, we expect children to be at chance at picking the unique toy. If children have an adult-like understanding of the uniqueness requirement and they are able to compute a scalar implicature that the speaker should have used the definite article if the unique toy was intended, they should pick one of the two non-unique toys. However, given that children have difficulty computing implicatures at this age (see e.g., Pouscolous, 2012; Papafragou & Musolino, 2003; Geurts, 2010; Guasti et al., 2005), we expect that they will be at chance in picking the unique toy or one of the two non-unique toys. We set the chance level here at 33%, because children can pick from three choices.

The difference between expected behavior with definites vs. indefinites leads to an expected main effect of construction type in Group 1: the unique toy should be selected more often across all three context conditions when Froggy uses the definite article than when Froggy uses the indefinite article (see Figure 2).

Regarding the definite article, we estimate that the visual context should suffice in establishing the visually unique toy as the only available referent for the definite article in the ‘No Extra Attention’ context (see the leftmost black column). Accordingly, if children are adult-like in their comprehension of the definite article, they should pick this toy. However, as no other contextual clue is given, they may not be at ceiling.
When the experimenter pays special attention to the visually unique toy (‘Attention to Unique Toy’, middle black column), the visual context is reinforced through the behavior of the experimenter, who makes the already visually unique toy salient by talking about it. In this case, the unique toy is both unique and salient and so children should be at ceiling when hearing the definite article.

Lastly, when the experimenter draws attention to one of the two non-unique toys (‘Attention to Non-Unique Toy’, rightmost black column), the visual context is competing with the actions of the experimenter: while visually, the unique toy stands out, the experimenter singles out one of the two non-unique toys as the salient one. When hearing the definite article, children could stick to the visually unique toy and choose that one as the referent, but they could also reinterpret the definite article in picking out that toy which is unique by virtue of having been talked about by the experimenter. Note that this interpretation of the situation goes along a standard interpretation of the definite article. We expect that children should stick to the visual context no matter the manipulations made by the experimenter. However, due to the strong competition, they may pick the unique toy to a lesser extent when hearing the definite article than in the other two contexts, while still being above chance.

3.5.2. Group 2: Definites vs. Pronouns

We expect different results for Group 2. Here, children should pick the salient toy when Froggy utters a pronoun, irrespective of whether the toy is the visually unique one. On the other hand, when children hear the definite article, they should still pick the visually unique toy no matter the context and behave as the children encountering the definite article in Group 1. This leads to an expected interaction between construction and context type (see Figure 3). The type of context should play a much bigger role for pronouns than for definites, as only for pronouns, the choice of referent depends on salience and salience differs from context to context, while (at least visual) uniqueness stays the same.
More specifically, in the ‘Attention to the Unique Toy’ context (two middle columns), the visual context and the experimenter’s manipulation both target the unique toy, thus children should always be at ceiling picking it both when hearing the definite article and the pronoun, as the unique toy is the salient toy.

When the experimenter draws special attention to one of the two non-unique toys (two right-most columns), we still expect children to be above chance in picking the visually unique toy when hearing the definite article (see the black column). However, with the pronoun, they should never pick the unique toy when one of the other toys is made salient, so here we expect children to never pick the visually unique toy (see the white column, or rather its absence).

Lastly, when the experimenter doesn’t draw attention to any toy (two leftmost columns), the context doesn’t meet the salience requirement. When Froggy uses a pronoun out of the blue, we expect children to be at chance in picking the unique toy, as nothing else in the context can guide their choice (see white column). The expectations for the definite article are the same as for Group 1. Children should be above chance in picking the unique toy, as the visual context satisfies the uniqueness presupposition.

3.6. Statistical Analysis

The binary dependent variable UNIQUE (1 = unique object; 0 = non-unique object) was analyzed according to a 2x3 design with a Generalized Linear Mixed Model (GLMM) with a logit link function in R (R Core Team (2014)). The two fixed factors were the three-level factor CONTEXT (No Attention, Attention to Unique Toy, Attention to Non-Unique Toy) crossed with the two-level factor CONSTRUCTION (Gr. 1: definite vs. indefinite article; Gr. 2: definite article vs. pronoun); intercepts of participants and items were used as random factors. The ‘No Attention’ condition was determined as a reference condition for the three-level factor CONTEXT, i.e., the two contrasts compared the ‘Attention to Unique Toy’ and the ‘Attention to Non-Unique Toy’ to the ‘No Attention’ condition.
3.6.1. Results Definites vs. Indefinites

Overall, the main finding for Group 1 is that no main effect of construction can be observed (see Figure 4). If children were sensitive to the uniqueness presupposition of the definite article, we would expect them to pick the unique toy across all three contexts significantly more often when Froggy uses the definite article than when he uses the indefinite article. However, they pick the unique toy to the same extent regardless of which article is used. We observe a statistically significant contrast ($p = 0.0265; z$-value $= 2.22; SE = 0.418$) comparing the context where the unique toy is made salient with the context where nothing is made salient. Here, the selection of the unique toy only depends on which toy has been made salient in the context, no matter which construction is used. These results mean that either children are not sensitive to the uniqueness presupposition of the definite article, or our task does not provide a strong enough clue for uniqueness.

![Figure 4: Selection of the Unique Toy: DEF/INDEF, Three-year-olds, Original Material](image)

More specifically, in the context ‘No Extra Attention’ (two leftmost columns), children pick the unique toy roughly 40% of the time both when the definite and when the indefinite article is used. This is not statistically different from chance. This finding suggests that the visual context alone is not a strong enough clue for uniqueness or, as stated above, that children have not mastered the uniqueness requirement yet. In the ‘Attention to Unique Toy’ context, children are significantly above chance in picking the unique toy. However, this is the case whether the definite or the indefinite article is used. In the ‘Attention to Non-Unique Toy’ condition, children behave as in the ‘No Extra Attention’ context, they are roughly at chance in picking the unique toy, both when Froggy utters the definite or the indefinite article. In other words, the visually unique toy doesn’t serve as a clear referent in the case of the definite article, but neither does the salient toy.

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3In addition to the GLMM and in order to assess whether the relative frequencies in the context conditions (irrespective of CONSTRUCTION) deviate significantly from chance, we computed the confidence intervals for each context condition in each group. If the logit-transformed guessing probability of one third (transformed: $-0.693$) lies beyond the confidence interval, we consider the frequency to differ significantly from guessing.
Overall, these results suggest one of three possibilities. Either three-year-olds have not mastered the uniqueness presupposition yet, or the visual context is not sufficient in singling out the unique toy, or our material is not fit to test children’s sensitivity to uniqueness adequately. With respect to this third possibility, one methodological concern that arises is the way the toys are presented, as pictures on flashcards. The two non-unique toys are represented by two identical pictures. This could lead to a reasoning where these two toys are interpreted as two tokens of the same type of toy and that there being two of them does not really matter, because Froggy identifies the type of toy he wants to pack. In this case, the distinction between unique and non-unique toys vanishes completely and the visual context wouldn’t meet uniqueness as a contextual requirement at all. Consequently, the only clue available for both constructions would be whether one of the two types of toys is made salient. Participants would just pick whichever toy is made salient.

Surprisingly, the adult results overall replicate the results of the children: there is no main effect of construction. Adults also pick the unique toy to the same extent regardless of which construction is used. The contrast between the two contexts ‘No Extra Attention’ and ‘Attention to Unique Toy’ observed with children is also significant in the adult data: the selection of the toy depends on which one is made salient.

The percentages in Figure 5 are almost identical to those in Figure 4: adults are at chance in picking the unique toy both when hearing the definite and indefinite article when nothing is made salient and when one of the two non-unique toys is made salient (see the black and white columns on the leftmost and rightmost side, respectively). The percentage of picking the unique toy increases when the unique toy is made salient, but here once again, this increase is observed for the definite and the indefinite article alike. This increase is significant for the comparison between the ‘No Extra Attention’ and the ‘Attention to Unique Toy’ context (p < 0.05; z-value = 2.44; Standard Error = 0.43).

Given that adults failed to pick the unique toy when the definite is used, it is possible that our material wasn’t fit to test the difference between the definite and indefinite article, and we cannot conclude anything about children’s sensitivity to the uniqueness presupposition of definites. We attempt to address this methodological concern in a follow-up study, reported on in section 3.6.3 below.
3.6.2. Results Definites vs. Pronouns

Overall, the results from Group 2 matched our expectations (see Figure 6): children pick the salient toy more often when hearing a pronoun than when hearing a definite.

![Figure 6: Selection of the Unique Toy: DEF/PRO, Three-year-olds, Original Material](image)

First, there is a significant contrast between the ‘No Extra Attention’ context and the ‘Attention to Non-Unique Toy’ context (p = 0.041, z-value = −2.04, Standard Error = 0.53). In the former, children generally pick the unique toy more often than in the latter. This is to be expected because at least in the pronoun case in the ‘Attention to Non-Unique Toy’ context, children only pick the unique toy 15% of the time, because it is not the salient toy. When Froggy uses the definite article in this context, children are still at chance in picking the unique toy. In the ‘No Extra Attention’ context, children are significantly above chance in picking the visually unique toy both when they hear the definite article and the pronoun ‘it’. Comparing the ‘No Extra Attention’ context and the ‘Attention to Unique Toy’ context, we find a significant interaction between context and construction (p = 0.035; z-value = 2.11; Standard Error = 0.82). The percentages of when children pick the unique toy when hearing the definite article (the two black columns on the left and in the middle) differ slightly across the two contexts. In other words, the additional contextual manipulation of making the already visually unique toy salient increases their choice for the unique toy slightly when hearing the definite article. However, it increases considerably when they hear a pronoun (see the two white columns on the left and in the middle). This finding is compatible with our expectations: only when the visually unique toy is made salient it is the appropriate referent for the pronoun. When nothing is made salient, there is also no appropriate referent for the pronoun. Overall, the results for Group 2 match our expectations.

The adult data for Group 2 (Definite Article vs. Pronouns) also looks promising (see Figure 7). We again observe that between the ‘No Extra Attention’ and the ‘Attention to Non-Unique Toy’ context, there is a significant interaction regarding context type and construction (p < 0.01, z-value = −3.15, Standard Error = 0.79): adults, like three-year-olds, pick the salient toy more often when a pronoun is used than when the definite article is used.
Specifically, in the ‘No Extra Attention’ context, adults are slightly above chance in picking the unique toy both when they hear a definite article and a pronoun (see the two leftmost columns, black for the definite article, white for pronouns). In turn, when one of the two non-unique toys is made salient (two rightmost columns), their selection of the unique toy decreases. The interaction arises because this decrease is more dramatic for pronouns than for a definite: adults almost never pick the unique toy when they hear a pronoun and the salient toy is one of the two non-unique toys (about 10% of the time, see the rightmost white column). They are, however, still at chance in picking the unique toy when they hear the definite article (see rightmost black column). In the ‘Attention to Unique Toy’ context, adults are clearly above chance in picking the unique toy in both cases, meaning when the definite article is used (black column in the middle) and when a pronoun is used (white column in the middle). However, the percentage in the pronoun case is slightly higher. Overall, the results of the adult sample match our expectations.

3.6.3. Results Follow-Up Study

To address the methodological concerns discussed for Group 1, we conducted a follow-up study, in which we tweaked the material to prevent the type/token confusion: we cut out all the toys to make them appear more life-like and we changed one of the two non-unique toys slightly, for instance by changing the color or by adding small dots or stripes to them. With this manipulation we hoped to create a situation where, even though the two non-unique toys can be identified as being the same type of toy, there are two distinct tokens of this toy and because of their differences, Froggy must be referring to the token rather than the type of toy when he says which toy he wants to pack.

We tested 12 native speakers of English (7 female, 5 male) in the Project of Children’s Language Learning at the University of Maryland, between the ages of 3;0 to 3;11 (mean age: 3;6).
The statistical analysis reveals that changing the material does not change children’s behavior (see Figure 8). We observe the same contrast ($p = 0.047$, $z$-value $= 1.98$, Standard error $= 0.45$) when nothing is made salient compared to when the unique toy is made salient. Whether Froggy uses the definite or the indefinite article, children pick the unique toy more often when it is made salient. An additional statistical test revealed that the difference between the original sample and the follow-up sample did not reach significance.

![Figure 8: Selection of the Unique Toy: DEF/INDEF, Three-year-olds, New Material](image)

While the change in material did not alter children’s behavior, it remains to be determined whether it will lead to an improved performance in adults. Pending these results, we can conclude that three-year-olds are not sensitive to the uniqueness requirement of definites, or that our task is not able to detect their sensitivity.

3.7. Discussion

Overall, the results of our experiment suggest that three-year-olds are adult-like in their comprehension of the salience requirement: salience, defined here as the experimenter’s attention to one of the available toys, guides the children’s choice when they hear a pronoun, but less so when they hear the definite article. This behavior is mirrored by the choices made by the adult controls. However, it is not clear whether three-year-olds are sensitive to the uniqueness requirement, or whether the set-up of the experiment can capture uniqueness in the first place, as the adult controls failed to pick the unique toy when hearing a definite article and failed to pick at random when hearing the indefinite article. Changing the material to prevent type/token confusions did not alter children’s responses.

There are, however, additional problems with the material that could make it unfit for testing for uniqueness with adults: the toys represented on the cards are objects existing in the real world. While these should be unusual enough for children not to know or recognize them, adults clearly know a majority of these objects and their names. This alters the experiment, even though the experimenter makes clear that Froggy is a funny guy who has his own names for these toys. Still, just by virtue of the toys being known to the adults, their reasoning could be different in that they might wonder which connection there could be between the object, its real world name, and its fantasy name. In other words, while a novel word task is quite
natural for young children, it may be unnatural for adults, especially if the objects are familiar. If they reason this way, then the grammatical input of the definite article or the indefinite article becomes less important. This extra-linguistic factor could only be excluded if we would present them with truly novel objects. We leave this manipulation for future research.

Another basic problem with the set-up of the experiment could lie in the disregard of familiarity. We have excluded the requirement of familiarity from this study, as both pronouns and the definite article require their referents to be familiar. However, all the toys in the experiment are unfamiliar to the child and they are only established as familiar through drawing attention to them. Thus, especially in the ‘No Extra Attention’ context, introducing the toys visually could be insufficient to establish familiarity, and thus referring to the unique toy with a definite article might seem odd in the first place. This factor could influence the choice in the ‘Attention to Non-Unique Toy’ context, where the visually unique toy might not be familiar on the basis of the visual situation alone, and thus could be disregarded as a competitor for the salient toy. However, results of previous studies (e.g., van Hout et al., 2010) show that the visual context makes a referent familiar in guiding children’s interpretation.

4. Conclusion

This experiment tested whether three-year-olds are adult-like in their comprehension of the different contextual requirements for the use of definites and pronouns. Following Roberts (2003), we assume that definites require uniqueness, while pronouns require salience. Our results show that children are adult-like in their sensitivity to salience in their comprehension of pronouns, compared to definites. However, they failed to show sensitivity to the uniqueness requirement on the use of definites. We leave to future research whether this failure is due to an experimental artifact or reflects a genuine delay in children’s comprehension of the use of the definite article.

References
Painting cows from a type-logical perspective
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Abstract. Depiction verbs such as paint license i(mage)- and p(ortrait)-readings; for instance, Ben painted a cow can convey that Ben produced an image of an unspecific cow or a portrait of a specific cow. This paper takes issue with a property-based intensional analysis of depiction verbs (Zimmermann, 2006b, 2016) and instead argues for an extensional account. Accordingly, the i-reading is rooted in the introduction of worldly representations by the explicit noun cow as such, whereas the p-reading is rooted in the interpolation of an implicit representation via coercion. This take on the ambiguity captures the following key traits. On i-readings, only representations are accessible to quantifiers and anaphors; moreover, intensional effects such as substitution failure disappear once ordinary objects and representations are adequately distinguished. P-readings, by contrast, involve representations that depend on the portrayed ordinary objects as particulars; correspondingly, only ordinary objects are accessible to quantifiers and anaphors. The proposal is spelled out in Asher’s (2011) Type Composition Logic.

Keywords: depiction verbs, visual representations, intensional transitives, coercion, Type Composition Logic.

1. Introduction

This paper is concerned with the interpretation of depiction verbs such as paint (draw, sculpt, . . .) in combination with a direct nominal object. Examples based on an indefinite noun phrase such as (1) have (at least) two readings (Goodman, 1969; Moltmann, 1997; Forbes, 2006; Zimmermann, 2006b, 2016).

(1) Ben painted (drew, sculpted, . . .) a cow.

According to the first reading, Ben produced a portrait of a cow of flesh and blood. I will call this the p(ortrait)-reading (following Goodman’s suggestion). According to the second reading, Ben produced an image of what cows visually amount to in general (that is, a cow-picture in Goodman’s words). I will call this the i(mage)-reading. The indefinite seems to receive a specific (de re) construal on the p-reading, as in (2a), and an unspecific (de dicto) construal on the i-reading, as in (2b). Correspondingly, directly referring proper names only allow p-readings, as in (3).

(2) a. ‘There is a specific cow that Ben produced an image of.’
   b. ‘Ben produced an image of an unspecific cow.’

(3) Ben painted Bella.

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The availability of unspecific readings is usually considered a hallmark of intensional transitive verbs such as seek; compare the contrast between seek and the extensional verb meet in (4). Moreover, on the i-reading, paint complies with the second hallmark of intensional transitives, namely, failure of the substitution of extensionally equivalent expressions salva veritate, as shown by (5). (On the p-reading, the entailment in (5a) would of course go through.)

(4) Ben {sought / #met} a baker, but no particular one.

(5) Let all bakers be joggers and let all joggers be bakers.
   a. Ben {sought / painted} a baker. \(\rightarrow\) Ben {sought / painted} a jogger.
   b. Ben met a baker. \(\rightarrow\) Ben met a jogger.

Zimmermann (2006b, 2016) distinguishes p- and i-readings from a third reading, which is particularly evident in examples such as (6), where the nouns undoubtedly denote representational artifacts. On the face of it, the third reading contrasts with both the p- and the i-readings by the fact that the noun as such denotes the object produced. I will call it the i(mage)\(N\)-reading.²

(6) Ben painted {a portrait of a cow / a circle}.

It is still not settled how to derive the various readings and their properties in a systematic way. I will contribute the following new perspective to this task. In Section 2, I will review the crucial descriptive properties of depiction verb constructions. The upshot will be that, despite initial appearances, depiction verb constructions should be given an extensional analysis. In Section 3, I will develop a corresponding meaning adaption account that builds on Asher’s (2011) Type Composition Logic. Specifically, two interacting hypothesises will be proposed. First, nouns presuppose the justification of disjoint types consisting of the object-type and its corresponding representation; that is, cow relates to either cowns of flesh and blood or their representations. Second, depiction verbs such as paint select for representations, but license local coercion from objects to representations if a type-conflict arises. In a nutshell, then, i\((N)\) readings go back to a type-logical ambiguity in the noun itself, whereas the p-reading goes back to the interpolation of an implicit representation. In Section 4, I will defend the adaption account against a property-based intensional alternative as suggested by Zimmermann (2006b, 2016). Section 5 offers a conclusion and a brief outlook.³

2. Review of descriptive properties

2.1. Readings and determiners

For the following discussion, some general background information on determiners is in order. Following Milsark (1977), two groups of determiners can be distinguished. Weak determiners such as a are grammatical in there-constructions (There is a cow on the street), whereas

²Zimmermann (2006b, 2016) mentions a fourth reading, which is exemplified by Ben painted a wall (red). Here, paint relates to the application of (red) paint to the wall’s surface. I will not discuss this reading here.

³Depiction verbs trigger the so-called imperfective paradox (known for creation verbs in general); that is, Ben was painting a circle does not entail that he painted a circle. As this (putatively) intensional effect does not directly bear on the ambiguity relevant here, I will not address it; see von Stechow (2001) and Forbes (2006) for discussion.
strong determiners such as *every* or *both* are not (*There {is every cow / are both cows} on the street). This has a discourse-structural correlate. Roughly, weak determiners can yield non-presuppositional interpretations; strong determiners, by contrast, presuppose their domain (see Heim and Kratzer 1998: ch. 6 for an introductory discussion). With this in mind, we will return to *paint* and its readings.

While weak determiners license both p- and i-readings (see the examples in Section 1), strong determiners license p-, but resist (certain) i-readings (Forbes, 2006; Zimmermann, 2016). Correspondingly, (7) can be understood as in (7a), but not as in (7b).

(7) Ben painted {every cow / both cows}.
   a. = ‘For {every / both} cow(s) of flesh and blood: Ben painted {it / them}.’
   b. ≠ ‘Ben painted an image of the fact that {every / both} cow(s) of flesh and blood {is / are} present.’

For Zimmermann, this restriction is a key argument against a propositional take on i-readings. If one captured the relation between *paint* and its nominal object via some intensionalized predication (the minimal requirement being something like *be present or exist*), (7b) should be possible, contrary to fact. This is convincing; however, it is clearly not the full story. Notably, as also pointed out by Zimmermann (2016: 443), strong determiners are compatible with i$_N$-readings. Crucially, this holds true not only for representational nouns, as in (8), but also for nouns that *prima facie* do not denote representations, as shown by the examples in (9). According to the given contextual information, the relevant presupposed entities are cow pictures instead of cows of flesh and blood.

(8) [exhibition of {many / two} cow pictures] Ben painted {every / both} cow picture(s).
   = ‘For {every / both} cow picture(s): Ben painted {it / them}.’

(9) a. [exhibition of {many / two} cow pictures] Ben painted {every / both} cow(s).
    = ‘For {every / both} cow picture(s): Ben painted {it / them}.’
   b. [picture with many cow representations] Ben painted every cow in this picture.
    = ‘For every cow representation: Ben painted it.’

In principle, this i$_N$-reading exists for (7) as well. However, the context-free presentation provokes the accommodation of entities that correspond to the ordinary meaning of the noun, which yields a p-reading. I will not dwell here on the question of whether this default amounts to a linguistically relevant asymmetry. For the time being, the key observation is just that (given contextual support) nouns can denote representations quite generally. Correspondingly, a strong determiner’s restriction can relate to the relevant representations as contextually given, fully independently of the depiction verb in its scope. This point of view can be strengthened by the observation that representational readings are in fact independent of a verbal lexical trigger, as shown by (10) (following Partee 2010: fn. 6 and Asher 2011: (9.10b)).

(10) a. [picture book] Where is the cow? There is the cow!
   b. [clothes shop] I like the dress with the flowers.
The obvious follow-up question is whether i-readings are in fact variants of i\textsubscript{N}-readings and, thus, rooted in the representational sense of the noun as well. The difference would just be the following. With a weak determiner, the corresponding existential quantification introduces a discourse-new representation; this blurs the fact that it is rooted not in the verb, but in the noun. With a strong determiner, by contrast, the relevant representations are treated as discourse-old such that they can feed the determiner’s restrictor; this givenness renders it transparent that the verb in the scope cannot be the source of the representation. Notably, this uniform perspective on i-readings provides an easy explanation for why the putative i-reading with strong determiners in (7b) is out. According to (7b), the representation (or, image) is supposed to be independent of the quantificational force of the determiner and its nominal argument. In other words: as on the p-reading in (7a), the quantification is said to target cows of flesh and blood. However, if i-readings are rooted in the nominal argument itself, the quantifying determiner cannot be independent of the representation, but it must target it. I-readings thus do not build on some intensional relation between depiction verbs and nominal objects, but on ordinary extensional quantification over entities in the world, namely, representations.

This extensional approach can be substantiated from two further angles (and one more will be discussed in the following section). The first relates to the substitution failure repeated in (11).

\begin{enumerate}
\item Let all bakers be joggers and let all joggers be bakers.
\item Ben painted a baker. $\rightarrow$ Ben painted a jogger.
\end{enumerate}

From the extensional perspective, the explanation for this is simple. The premise in (11a) relates to the identity of joggers and bakers of flesh and blood in a particular situation. Since this does not say anything about the identity of representations in that situation, the entailment in (11b) does not go through on the i-reading. In other words, the putative intensional effect in (11) is based on mixing the non-representational and the representational meaning of the involved nouns. Crucially, the effect dissolves once the distinction between objects and their representations is controlled for. Given a premise that relates to representations as in (12a), (12b) is valid on the i-reading, irrespective of the fact that cow and cow without horns are intensionally distinct (with the latter being stronger than the former). This observation, which seems to have gone unnoticed so far, is fully expected on an extensional account.

\begin{enumerate}
\item Let all paintings of cows by Ben be paintings of cows without horns.
\item Ben painted a cow $\rightarrow$ Ben painted a cow without horns.
\end{enumerate}

Second, Moltmann (1997) shows that run-of-the-mill intensional verbs such as need are not relativized to possible worlds as wholes, but to parts of worlds, namely, situations that minimally obey certain restrictions. This comes out in combination with weak determiners that are not (right) upward monotone such as exactly two or no\textsuperscript{4}. For instance, (13a) is true iff for all minimal situations that satisfy Ben’s needs, Ben has \{exactly two / no\} cows. Crucially, this is compatible with Ben \{having more than two / having\} cows in non-minimal satisfaction situations and, thus, accounts for the observation that (13a) does not entail (13b).

\textsuperscript{4}The monotonicity property is, for instance, indicated by the fact that \{Exactly two cows / No cows\} are mooing loudly does not entail \{Exactly two cows / No cows\} are mooing.
Depiction verbs are different. On the i-reading, (14a) is true iff there are exactly two cow representations (be they in one picture or in two separate pictures). That is, (14a) would be false for an image that involves more than two cow paintings and that would thus be non-minimal. Similarly, (14b) enforces the lack of any cow paintings by Ben for a situation it describes truthfully.

(14)  

a. Ben painted exactly two cows.  

b. Ben painted no cows.

I conclude that, even on i-readings, depiction verbs do not relate to minimal satisfaction situations and are, thus, of a different ilk than intensional verbs. Instead, the explicit quantifying determiner yields a usual extensional quantification over representations.

2.2. Anaphors to representations on i-readings

If i-readings generally build on ordinary extensional quantification, the quantified representations should generally be accessible to definite anaphors. This, however, is disputed by Zimmermann (2016) for i-readings with a weak determiner. His cases in point are given in (15).

Crucially, the definite anaphor it calls for an explicit reference to pictures in the preceding sentence, which seems to be at odds with the assumption that the noun camel as such can introduce pictorial objects.

(15)  

a. Ken painted #(a picture of) a camel. It is exhibited in the Louvre.  

b. That is #(a picture of) a camel, and I’ll put it in my pocket.  

[see Zimmermann (2016), (65)–(66), where (66) is attributed to Kripke (2013)]

I consider this reasoning flawed in two respects. First, (15a) and (15b) suggest anaphoric links to the media on which the representations are displayed. However, the extensional approach merely says that nouns can introduce the representations themselves, but not these media. Once this distinction is controlled for, anaphors to representations are licit; see (16a), where turn out selects representations instead of media, or (16b) and (16c), where medium and representation coincide. (I owe (16c) to C. Fortmann.)

(16)  

a. Ken painted a camel. \( r_{repr} \) turned out very beautifully.  

b. Ken drew three camels, cut them\( r_{repr/med} \) out, and stuck them\( r_{repr/med} \) to the wall.  

c. Ken sculpted a camel and put \( r_{repr/med} \) in his pocket.

The German examples in (17) are even more revealing. They show that the definite anaphor to the relevant representation covaries in gender with its nominal antecedent. This only follows smoothly from tying the introduction of the representation to the noun.
Ken has painted \{a camel, a cow, a dog\}. It turned out very beautifully.

Second, (15b) involves a further complication. Without a specific context and without a picture of, the first part of the sentence suggests the non-representational sense of camel, which renders the representational sense inaccessible for the subsequent anaphor (see the further discussion for more on the ‘destructive’ nature of the disambiguation). As there is no depiction verb, the introduction of a representation cannot be traced back to the selection by the verbal predication, which, however, should be the case on the putatively intensional i-reading (recall the discussion in Section 2.1). Instead, the corresponding referent must be established independently. Once this is warranted by a context such as in (18), (15b) becomes felicitous, as expected under the extensional approach.

Let me turn to a slightly different source of potential counterevidence. Moltmann (1997: 48–49) argues that i-readings are intensional, as they would prohibit definite anaphors and support only impersonal proforms. (For reasons of space, her considerations of identity conditions will not be discussed here.) Her examples look like those in (19) and (20). In (19), the definite anaphors render the i-reading inaccessible; in (20), proforms and possible readings covary.

I agree with the judgments, but not with the conclusion. The example in (19) is special because it involves the depiction verb twice. This calls for two representations, as the produced object is bound to its agent here. Therefore, Mia cannot paint the representation already painted by Ben, which excludes the i-reading. The p-reading, by contrast, is fine because the very same old man or table can be portrayed several times. Two further observations support this reasoning. For one, the restriction to multiple representations carries over to examples based on representational nouns, as shown by (21a), while these undoubtedly license definite anaphors, as shown by (21b). Thus, the restriction observed in (19) cannot be due to the putative intensionality of i-readings.\(^5\)

| 18 | [A grandmother shows her grandson several small sculptures of animals.] That is a camel, and I’ll put it in my pocket. Which one would you like to have?  |
| 19 | Ben painted \{an old man, a table\}, and Mia painted \{him, it\} too. only p-reading  |
| 20 | a. What did Ben paint? – An old man. only i-reading  |
| 21 | a. #Ben painted a picture, and Mia painted it too.  |
| 5 | Notably, anaphors to pictures in cases such as (21b) are also accepted by Zimmermann (2006a: 758–759). In fact, he considers them a problem for the particular intensional analysis of paint he provides for such cases.
Moreover, definite anaphors are felicitous once a depiction verb variant is chosen that does not involve a functional relation between agent and theme and thus escapes the proposed restriction. A case in point is (22). *Malen an etwas* (‘contribute to the painting of something’) in German does not necessarily map the produced representation to the explicit agent alone. Correspondingly, the anaphor is fine on an i-reading.

(22) Ben malte an einer riesigen Kuh. Mia malte auch an ihr.
    ‘Ben contributed to the painting of a huge cow, and so did Mia.’

The evidence drawn from the minimal pair in (20) is not convincing either. Crucially, the restriction to impersonal proforms on i-readings extends to extensional verbs. For instance, given coreference to a representational object, *touch* is equally incompatible with a personal proform; see (23). That is, the ban on *whom* is not rooted in intensionality, but in the nature of representations.

(23) {What / #Whom} did Ben touch? – (A sculpture of) An old woman. He was interested in the surface feel of its material.

I conclude that, upon closer inspection, anaphoric references clearly support an extensional instead of an intensional approach to i-readings of depiction verbs. Let me finally note that i-readings block anaphors to the ordinary object interpretation, as shown by (24).\(^6\) (I owe (24c) to C. Maienborn.)

(24) a. #Ben painted {a cow\(_{repr.}\) / an old man\(_{repr.}\)}. {It\(_{animal}\) / He\(_{human}\)} was called {Bella / Paul}.
    b. #Ben painted a cow\(_{repr.}\). It\(_{animal}\) had eaten a lot.
    c. #Ben painted an old man\(_{repr.}\). He\(_{human}\) was very flattered.

This is again indicative of the fact that the specification to one reading disables the other.

2.3. Specific features of p-readings

On p-readings, the noun seems to convey its ordinary meaning: *a cow* introduces a cow of flesh and blood. However, *paint* is still a creation verb and thus involves a representation (the produced portrait). This begs the question of how this representation comes into play and of how it differs from representations on i-readings. Descriptively, three aspects are noteworthy.

First, while i-readings only support anaphors to representations, p-readings show the reversed pattern: they are only compatible with access to the portrayed objects, as shown in (25). That is, any analysis must assure that the portraits, though conceptually present, are kept anaphorically opaque.

\(^6\)Of course, a painter could call his work of art Bella and thereby suggest that the depicted object is the cow Bella. Even then, however, the anaphors in (24a) would not directly refer to these objects of flesh and blood.
Lisa painted \{a horse from this farm / every horse from this farm\}.

a. It was called Lucky. / They were called Lucky, Rusty, and Misty.
b. #It turned out beautifully. / They turned out beautifully.
c. Then she fed \{it / them\}.
d. #Then she cut \{it / them\} out and stuck \{it / them\} to the wall.

The second observation relates to twin scenarios such as (26).

(26) [Bella and Mia are cow twins that resemble each other to a perfect degree.] Ben painted Bella. The portrait would have been the same if he had painted Mia. But he painted Bella.

As pointed out by Zimmermann (2006b), such scenarios show that p-readings are feasible in situations where uniquely identifying properties of the objects portrayed are missing. I conclude that the representations on p-readings should be made dependent on these referential objects. Correspondingly, these representations are of a very different nature than representations on i-readings. Specifically, they are not rooted in the descriptive content of the explicit noun, but evolve from the interaction between the verb and the referent introduced by the noun phrase as a whole.

The third observation points in the same direction. Consider a situation with Lucky being a stocky, short-legged horse with a round belly and Rusty being a rangy, extraordinarily slender horse. A painter could portray Lucky by painting a circle and Rusty by painting a line. However, neither circle nor line would be considered truthful horse representations in the sense of i-readings. In words adapted from Zimmermann (2016: 427) (and Goodman 1969), a portrait of a horse need not be a horse-picture. This follows smoothly from the suggested distinction between the source of representations on i- as opposed to p-readings. According to Section 2.1, representations on i-readings are rooted in the noun, which explains why they are closely linked to the property associated with that noun; they must be reasonably truthful images of the visual appearance of horses in general (see Section 3.1 for further details). On p-readings, by contrast, representations depend on the nominal referent and, thus, must be reasonably truthful images of what this referent is. The underlying noun merely helps in picking out the portrayed referent; this bears indirectly on what the portrait might look like, but, strictly speaking, the portrait is independent of the noun chosen.

2.4. Interim conclusions

Combinations of depiction verbs such as paint with a nominal object are ambiguous between i(mage)- and p(ortrait)-readings. Their analysis should comply with the following key traits. First, both weak and strong determiners license both i- and p-readings. The relevant quantification operates on an extensional level: while it targets representations in the world on i-readings, it targets ordinary objects in the world on p-readings. The choice of weak as opposed to strong determiners specifies in a regular way whether the representation is newly introduced into discourse via the clause under consideration, or, whether it is presented as discourse-old. This
makes for the (wrong) impression that only i-readings based on strong determiners are rooted in the explicit head noun. Second, the accessibility of anaphors to representations as opposed to the objects represented covaries with the given reading. Anaphors to representations are feasible on i-readings, but not on p-readings; anaphors to the objects represented are feasible on p-readings, but not on i-readings. Third, in contrast to representations associated with i-readings, representations associated with p-readings are independent of the given head noun, but dependent on the portrayed object as introduced by the noun phrase as a whole.

3. Adaption analysis

The adaption analysis I will propose builds on Asher’s (2011) type-logical approach to semantic composition. In Asher (2011), semantic representations comprise—besides the usual logical forms—rich typing information. In particular, predicates introduce (fine-grained) type presuppositions for their arguments; the composition succeeds if these are either satisfied directly or made satisfiable by non-random adaptive mechanisms. The lexical entry for bank in (27) and the example in (28) serve as illustration.\footnote{As this suffices for illustrating the core idea, the typing is simplified; see Asher (2011: ch. 6.3) for details. Specifically, the typing ignores that bank can also refer to buildings that host financial institutions.}

$$(27) \quad [\text{bank}] = \lambda x \lambda \pi. \text{bank}(x, \pi \ast \text{ARG}_{1}^{\text{bank}} : \text{LOC} \lor \text{INST})$$

$$(28) \quad \text{I entrust my money to this bank}_{\text{INST}} (#\text{although the soil of it}_{\text{LOC}} \text{is very sandy}).$$

Predicates come along with arguments for contextual parameters $\pi$. These parameters encode the relevant presuppositions, the addition of which is symbolized by $\ast$. According to (27), the predicate bank presupposes that its first argument ($= x$) is of type location ($= \text{LOC}$) or of type institution ($= \text{INST}$). This disjunctive type captures that $x$ can be either a river bank or a financial institution (but not both). In (28), the predicate entrust money selects an object of type INST, which can easily be satisfied by the disjunctive type offered by bank via so-called Simple Type Accommodation: $(\text{LOC} \lor \text{INST}) \cap \text{INST} = \text{INST}$. Notably, the choice of the type INST disables access to the type LOC. Therefore, the continuation with soil, which presupposes the type LOC for the anaphor it, is infelicitous. With this general set-up in mind, let us turn to the combinatorics of depiction verbs.

3.1. Adaption analysis: I-readings

The first crucial assumption is that lexical units such as cow are ambiguous between an object reading and a representation reading. The hypothesis H1 in (29) captures this in type-logical terms.

$$(29) \quad \text{H1: Lexical units such as the noun cow presuppose the justification of disjoint types consisting of object type and object representation type; for cow: } \text{ANIMAL} \lor \text{R}_{\text{ANIMAL}}.$$
For the main purpose of this paper, a rough characterization of such lexically given representations suffices. They are artifacts that share visually accessible properties with corresponding ordinary objects in general. The similarities must guarantee that the kind of object represented is recognizable as such according to some contextual standard (for instance, the criteria for what counts as a reasonably truthful artifact is different for a textbook on biology than for a caricature). Notably, this similarity-based characterization closely follows the characterization of images sketched in other approaches such as Forbes (2006) and Zimmermann (2006b, 2016). What sets my approach apart is that these representations are rooted in the fine-grained presuppositional content of lexical units. This begs the question of how general the underlying ambiguity is. The natural assumption is that it extends to all expressions that denote visually accessible entities. In fact, it does not matter whether the object represented is animate or inanimate, whether it is described in simple or complex terms, or whether it is a physical or an eventive entity. An i-reading is possible for all of them, as in (30).

(30) Ben painted \{a cow / a stone / a brown cow with huge ears / a soccer match\}.

Therefore, in contrast to the accidental ambiguity observed for *bank*, the ambiguity between representations and ordinary objects must have a systematic source. However, I will not speculate about this source and its repercussions on lexical meaning in general here. Instead, I will consider how far H1 gets us for the interpretation of depiction verb constructions.

For the example in (31) with a weak determiner (see (1) and (16a) from above), the relevant lexical entries are given in (32).

(31) Ben painted a cow. (It turned out beautifully.)

(32) a. \[\text{cow} = \lambda x \lambda \pi . \text{cow}(x, \pi \star \text{ARG}_{1}^{\text{cow}} : \text{ANIMAL} \lor \text{R}_{\text{ANIMAL}})\]
   b. \[\text{a} = \lambda Q \lambda P . z \lambda x . [Q(x)(\pi) \land P(x)(\pi)]\]
   c. \[\text{paint} = \lambda \Psi \lambda z \lambda \pi . \Psi(\lambda y \lambda \pi' . \text{paint}(z, y, \pi'))(\pi \star \text{ARG}_{2}^{\text{paint}} : \text{R})\]

Following H1, the entry for *cow* in (32a) says that the first argument of the predicate *cow* must be either an animal or a corresponding representation. The entry for *paint* in (32c) says that the second argument of the predicate *paint* must be a representation; this captures the intuition that *paint* necessarily involves the creation of a representational object and binds this object as its second argument. (In order to keep things simple, requirements regarding the subject argument are omitted.) The entry in (32b) takes *a* to be a usual extensional quantifier (enriched by contextual parameters \(\pi\)). Composing these entries in a regular way yields (33).

(33) \[\text{paint a cow} = [\text{paint}](\text{a}(\text{cow})) = \lambda z \lambda \pi \exists x . [\text{cow}(x, \pi \star \text{ARG}_{2}^{\text{paint}} : \text{R} \star \text{ARG}_{1}^{\text{cow}} : \text{ANIMAL} \lor \text{R}_{\text{ANIMAL}}) \land \text{paint}(z, x, \pi \star \text{ARG}_{2}^{\text{paint}} : \text{R})]\]

---

For instance, Forbes (2006: 72), summarizing Peacocke (1987), writes: “[...] a depiction of, say, a dog, is something which, when viewed in appropriate conditions, is presented in a region of the visual field experienced as similar in relevant respects (for instance, shape) to one in which it is possible for a dog to be presented”.

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8For instance, Forbes (2006: 72), summarizing Peacocke (1987), writes: “[...] a depiction of, say, a dog, is something which, when viewed in appropriate conditions, is presented in a region of the visual field experienced as similar in relevant respects (for instance, shape) to one in which it is possible for a dog to be presented”.
Notably, the contextual parameters are part of the composition and, thus, subject to ordinary \( \lambda \)-conversion. In turn, the percolation of presuppositions follows the compositional path. According to (32c), \textit{paint} assigns its presupposition to the outer parameter \( \pi \) (instead of the inner \( \pi' \)). As this \( \pi \) feeds the respective slot in the quantified argument \( \Psi \), \textit{paint} passes its presupposition on to the context parameter of its object, as shown by the result in (33). Correspondingly, the relevant site for the justification of both verbal and nominal presuppositions is the predication for \textit{cow}, that is, the quantifier’s restrictor. For (33), the presuppositions for \( x \) can easily be met by Simple Type Accommodation; see (34) and Asher (2011: (4.25)) for the corresponding generalized rule. After application to the subject, this yields the simplified result in (35). In prose: (31) is true iff there is a cow representation painted by Ben.

(34) \((\text{ANIMAL} \lor \text{R}\text{ANIMAL}) \sqcap \text{R} = \text{R}\text{ANIMAL}\)

(35) \[\text{Ben painted a cow } = \lambda \pi \exists x : \text{R}\text{ANIMAL} [\text{cow}(x, \pi) \land \text{paint} (\text{Ben}, x, \pi)]\]

This is intuitively correct. More specifically, the derivation introduces a particular cow representation that can be accessed anaphorically, as illustrated by the parenthesized continuation in (31). However, there is no particular cow of flesh and blood introduced, which captures why corresponding anaphors are blocked; recall example (24a), repeated in (36).

(36) \#\text{Ben painted } \{\text{a cow repr. } / \text{an old man repr.}\}. \{\text{It anim. } / \text{He hum.}\} \text{ was called } \{\text{Bella } / \text{Paul}\}.

This blocking of the alternative lexical meaning is the crucial reason for modeling the ambiguity in terms of disjoint types. Disjoint types allow a simple meet operation as in (34) and, thus, the exclusion of one of the original types. This contrasts with objects that justify so-called dual aspect types; for these, “both constituent types, the types of the aspects, are in some sense present” (Asher, 2011: 132). A prototypical example is \textit{book}, which denotes objects that are both physical and informational objects (type \text{PHYS} \bullet \text{INFO}). Predicates can select one or the other aspect. However, the corresponding accommodation cannot resort to a meet operation, as dual aspect types and simple types do not have a common meet (for instance, \((\text{PHYS} \bullet \text{INFO}) \sqcap \text{PHYS} = \bot\)). Instead, the accommodation introduces a new object of the relevant simple type without abandoning the original object bearing a complex type. Correspondingly, anaphors are licit even if the selecting predicates introduce incompatible type requirements, as in (37); see Asher (2011: ch. 5 and 6) for details on dual aspect types and their accommodation.

(37) \text{I read}_{\text{PHYS} \bullet \text{INFO}} \text{Elements of Symbolic Logic, did not understand}_{\text{INFO}} \text{it and, therefore, threw}_{\text{PHYS}} \text{it out of the window.}

The composition for i-readings with strong determiners is fully analogous. Based on the standard entry for \textit{every} in (38), the example in (39) (see (9) from above) receives the interpretation in (40). In prose: (39) is true iff for every cow representation, Ben painted it.

(38) \[\text{[every]} = \lambda Q \lambda P \lambda \pi \forall x [Q(x)(\pi); P(x)(\pi)]\]

(39) \[\text{[exhibition of many cow pictures] Ben painted every cow.}\]
\[ [\text{Ben painted every cow}] = [\text{paint} ([\text{every}] ([\text{cow}]))) ([\text{Ben}])] = \lambda \pi \forall x: \text{R}\text{ANIMAL} [\text{cow}(x, \pi); \text{paint}(\text{Ben}, x, \pi)] \]

This is adequate for the intuitively given i-reading. Recall from Section 2.1 that there is no i-reading according to which Ben painted an image of the fact that every cow is present. Given that the accommodation within the quantifier’s restrictor yields a quantification over cow representations, there is no way to derive this non-existent i-reading, as desired.

According to the terminology from the introduction, (31) exemplifies an i-reading, while (39) exemplifies an i\_N-reading. In Section 2.1, I argued for treating them on a par. The given derivations implement this by the uniform accommodation of representations via the representational type of the head noun within the quantifier’s restrictor. The intuitive difference between both cases follows from the independent observation that strong determiners such as every partition contextually given entities, here, representations, and weak determiners such as a allow their introduction as discourse-new entities. In other words, only with strong quantifiers is the accommodation of the representational type within the quantifier’s restrictor readily identifiable.

Against this background, it is finally worthwhile to reconsider the case where the head noun undoubtedly conveys a representational meaning, as in (41) (see (6) from above).

\[ (41) \quad \text{Ben painted a portrait.} \]

Interestingly, (41) has two i-readings. It can convey that Ben produces a portrait of, say, Mia; this is the most obvious standard reading, as already discussed in the introduction. In addition, it can convey that Ben produces an image of what portraits visually amount to in general, that is, a portrait-picture in Goodman’s terms. This observation might be puzzling, as it seems to bring back the original distinction between i\_N- and i-reading and thereby challenge their reduction to one mechanism. However, the given type-logical analysis has a simple explanation for the ambiguity without giving up the uniform treatment. According to H1, portrait involves a disjoint type; see (42). This entry is conceptually sound, as it is fully reasonable to assume that there are representations of representations.

\[ (42) \quad [\text{portrait}] = \lambda \pi \exists x: \text{REPRESENTATION} (\text{portrait}(x, \pi) \land \text{paint}(\text{Ben}, x, \pi)) \]

Crucially, this predicts that the accommodation within the restrictor has two options. It can resort either to the ordinary representational type, as sketched in (43a), or to the secondary representational type, as sketched in (43b).

\[ (43) \]

\begin{enumerate}
    \item \[ \lambda \pi \exists x: \text{REPRESENTATION} [\text{portrait}(x, \pi) \land \text{paint}(\text{Ben}, x, \pi)] \]
    \item \[ \lambda \pi \exists x: \text{R}\text{REPRESENTATION} [\text{portrait}(x, \pi) \land \text{paint}(\text{Ben}, x, \pi)] \]
\end{enumerate}

(43a) is the standard reading, and (43b) is the portrait-picture reading. In other words: as the accommodation for sui generis representational nouns can use either of both types of the given disjoint type, it triggers an ambiguity not observed for non-representational nouns such as cow.
3.2. Adaption analysis: P-reading

The example in (44) (see (7) from above) exemplifies the p-reading. Based on the lexical entries from Section 3.1, the compositional result in (45) is as it would be on a corresponding i-reading.

(44) [on a farm] Ben painted every cow.

(45) \[
\text{[Ben painted every cow]} = \text{[paint]}(\text{[every]}(\text{[cow]}))(\text{[Ben]})
\]

\[
= \lambda \pi \forall x : \text{ANIMAL}[\text{cow}(x, \pi \star \text{ARG}^\text{paint}_2 : R \star \text{ARG}^\text{cow}_1 : \text{ANIMAL} \lor R_{\text{ANIMAL}}); \text{paint}(\text{Ben}, x, \pi \star \text{ARG}^\text{paint}_2 : R)]
\]

However, the satisfaction of presuppositions is different. Crucially, on the p-reading, the given noun relates to (contextually given) cows of flesh and blood. Accordingly, the predication for cow within the quantifier’s restrictor should use the type ANIMAL for the specification of x’s type and, thus, ignore the type requirements brought in by the verbal predicate paint. This yields (46).

(46) \[
\text{[Ben painted every cow]}
\]

\[
= \lambda \pi \forall x : \text{ANIMAL}[\text{cow}(x, \pi); \text{paint}(\text{Ben}, x, \pi \star \text{ARG}^\text{paint}_2 : R)]
\]

Of course, x cannot be both a cow of flesh and blood and a painting. Therefore, as it stands, the global commitment to animals in the restrictor yields an unresolvable conflict in the nuclear scope. Nevertheless, the analysis seems to be on the right track. Recall the evidence from Section 2.3: the p-reading renders animals, but not their representations, accessible to anaphors; moreover, portraits can diverge in substance from the content of the explicit noun. So, the global commitment to cows of flesh and blood and the elimination of the representational type of cow is correct. Instead, the representation required by paint should be made available locally, that is, within the nuclear scope and thus independently of the global type specification in the restrictor. Notably, such locality effects are well known for coercion (see Asher 2011, Bücking 2014, Maienborn and Herdtfelder 2017 for discussion). For instance, enjoy selects an event. If the object does not comply with this restriction, a suitable event can be interpolated, as in example (47), which suggests a consumption event. Analogously to the findings for paint on p-readings, the interpolation is locally operative: the quantifying determiner three counts dishes instead of events. Therefore, (47) cannot convey that there are three consumption events involving just one dish.9 Furthermore, the anaphor they relates to dishes, but not to events.

(47) Mia enjoyed three dishes. They_dish/#consumption were great.

Given this parallel, I propose to complement hypothesis H1 by hypothesis H2 in (48).

(48) H2: Depiction verbs such as paint license local coercion from objects to their representations.

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9This is not a conceptual restriction. Let Mia eat a dish not all at once, but in three stages (morning, afternoon, evening). This is a situation with one dish, but three consumption events. But (47) cannot describe this situation.
In Type Composition Logic, coercion is rooted in the lexicon and thereby constrained by the linguistic system. Specifically, the coercive potential of lexical expressions is captured by so-called polymorphic types. Only these license the interpolation of additional material in order to resolve a pending type conflict. For *paint*, I propose the refinement in (49), which differs from the original entry in (32c) by including the polymorphic type $\rho(\text{HEAD}(\Psi))$. In a nutshell, this says that, if the second argument of *paint* is not a representation, the presupposition can be satisfied by interpolating a representation that is related to the head type of the explicitly given argument.

\[
\text{[paint]} = \lambda \Psi \lambda z \lambda \pi. \Psi(\lambda y \lambda \pi', \text{paint}(z, y, \pi'))(\pi \star \text{ARG}^\text{paint}_2: R - \rho(\text{HEAD}(\Psi)))
\]

Given (49), the revised compositional starting point for the example in (44) is (50). Notably, in order to render the type conflict local, the typing information as determined for *cow* within the restrictor is mapped onto the contextual parameter for *paint* in the nuclear scope.\(^{10}\)

\[
\text{[Ben painted every cow]} = \lambda \pi \forall x: \text{ANIMAL}[\text{cow}(x, \pi); \text{paint}(\text{Ben}, x, \pi \star \text{ARG}^\text{cow}_1: \text{ANIMAL} \star \text{ARG}^\text{paint}_2: R - \rho(\text{COW})]]
\]

The polymorphic type in (50) licenses so-called Type Accommodation with Generalized Polymorphic Types; see (51) adapted from Asher (2011: 225). According to (51), a $\mathcal{D}$-functor such as given in (52) introduces a mediating representation that meets the type requirement imposed by *paint* and that is linked to the given *cow*.\(^{11}\) In the revised result in (53), the second argument of *paint* and the first argument of *cow* differ. Therefore, all presuppositions can easily be satisfied, which yields the simplified adapted meaning in (54).

\[
\psi(v, \pi), \pi \text{ carries } \text{ARG}^P_1: D - \delta(\text{SUBTYPE}(A)) \star \text{ARG}^O_1: A, v \in \text{ARG}^P_1 \cap \text{ARG}^O_1, A \cap D = \bot
\]

\[
\mathcal{D}(\lambda w \lambda \pi' \psi(w, \pi'))(v)(\pi)
\]

\[
\lambda \pi \forall x: \text{ANIMAL}[\text{cow}(x, \pi); \exists y: \rho(\text{COW})[\phi_{\rho(\text{COW})}(y, y, \pi) \wedge P(y)(\pi)]
\]

\[
\lambda \pi \forall x: \text{ANIMAL}[\text{cow}(x, \pi); \exists y: \rho(\text{COW})[\phi_{\rho(\text{COW})}(y, y, \pi) \wedge \text{paint}(\text{Ben}, y, \pi)]
\]

In prose: (44) is true iff for every cow of flesh and blood, there is a representation that Ben painted of it. This is correct for the p-reading. Furthermore, it complies with all its specific

\(^{10}\)The reasoning in favor of local coercion is sound. However, the mapping of the nominal type onto the verbal predication in the nuclear scope does not follow from the composition of contextual parameters. Recall that the lexical entries only facilitate the mapping of the presuppositions of *paint* onto the presuppositions of *cow*. Coercion based on *enjoy* faces the same problem; therefore, Asher (2011: 223) stipulates that the type accommodation pertains to the nuclear scope. I leave this more general computational problem for further research.

\(^{11}\)I dispense with the detailed derivation here; it follows the steps as given for instance by (45) to (47) in Bücking (2014).
traits. The representations are introduced locally and are thus opaque for anaphors, and they do not depend on the nominal disjoint type, but on the particular objects of flesh and blood they are representations of: \( y \) must be a representation of each \( x \) as given by the restrictor. This both solves the puzzle with twin scenarios and conforms to the observation that representations on p-readings can be untruthful images of what the nominal property amounts to. Let me conclude with a brief remark on the instantiation of the underspecified predicate variable \( \phi \) for the interpolated representation. As the verbal predication is very specific, \( \phi \) can only be a predicate for paintings.\(^{12}\)


Zimmermann (2016) distinguishes between three approaches to i-readings: a proposition-based intensional analysis, a property-based intensional analysis, and a non-intensional so-called intentionless analysis. He convincingly argues against the propositional approach, which I will not recap here for reasons of space (but recall the remark on it in Section 2.1). Before turning to the property-based intensional alternative, a brief comment on the intentional approach is in order. The adaption account developed here amounts to one implementation of intentionalism; the general characterization in Zimmermann (2016: 445) says: “If the object position of a transitive verb appears to be intensional, the restrictor nouns of its objects need to be suitably reinterpreted so as to make them extensional.” I consider my proposal an elaborate defense of such an approach regarding depiction verbs, not least against Zimmermann’s own skepticism. Furthermore, in contrast to Zimmermann’s rough ideas on how suitable reinterpretations come into play, the present proposal provides specific hypotheses on their roots.

According to the property-based intensional analysis of i-readings, paint contributes a “relation between painters and properties that characterize the pictures painted by them” (Zimmermann, 2016: 442). I implement this as in (55)/(56) (which slightly modifies Zimmermann’s version).

\[
(55) \quad \begin{align*}
\llbracket \text{paint} \rrbracket &= \lambda_{P(e,(x,t))} y. \exists x [\text{paint}(y,x) \land \text{representation of}(x,P)] \\
\llbracket \text{a cow} \rrbracket &= \lambda z \lambda w. \text{cow}(z)(w)
\end{align*}
\]

\[
(56) \quad \llbracket \text{Ben painted a cow} \rrbracket = 1 \text{ iff } \exists x [\text{paint(Ben,x)} \land \text{representation of}(x,\lambda z \lambda w. \text{cow}(z)(w))]
\]

Contentwise, the representation relation does not differ substantially from its use within the proposed adaption account; in fact, as pointed out in Section 3.1, I basically follow the assumption made by Zimmermann and others that representations build on visual resemblance to possible ordinary objects as introduced by the nominal property. The crucial difference lies in their roots. While representations are introduced by the noun (i-reading) or by coercion (p-reading) in the adaption account, they are invariably rooted in the depiction verb in the property-based account (notably, without coercion in the relevant sense, as the adaption of properties for existential quantifiers underlying (55b) is of a different nature). This, however, poses several problems.

\(^{12}\)This is different from event coercion as based on \textit{enjoy}. Here, the specification varies according to the type of object and further contextual information. For instance, for (47) above, I assumed that Mia enjoyed the consumption of the dishes. However, in more specific contexts, she could also enjoy preparing them.
First, Zimmermann (2016: 443) points out that the property-based analysis is at odds with i-readings based on strong determiners such as every, as in (57). It lacks a plausible compositional derivation. Strong DPs are usually considered inappropriate for a shift to properties (as they are not existential). Moreover, even if the quantified DP could be shifted, this would not render representations sensitive to every; the representation would still be bound by the fixed existential quantifier in (56).

(57) exhibition of many cow pictures] Ben painted every cow here.

This problem can be strengthened. In Section 2.2, I pointed out that anaphors to representations are compatible even with i-readings based on weak determiners (contra Zimmermann’s assumption). Moreover, these anaphors are sensitive to grammatical features of the preceding object phrase. For instance, (58) (based on (16a) and (16b)) licenses a plural anaphor to representations. This is predicted by tying the representations to the explicit existential quantifier three camels, but it is fully unexpected once the representation is tied to some implicit existential quantifier given by the verb. (A similar argument follows from the gender agreement observed for German.)

(58) Ben drew three camels. They turned out beautifully.

A second source of trouble relates to the p-reading. Zimmermann (2006b: (13)) offers the standard de re-construal in (59) (again slightly modified). Crucially, the relevant property is presupposed to uniquely identify the portrayed object.

(59) \[Ben painted a cow\] = \[∃y∃P[cow(y) ∧ given qua(y, Ben, P) ∧ ∃x[paint(Ben, x) ∧ representation of(x, P)]]\]

However, as pointed out by Zimmermann himself, this is at odds with twin scenarios as discussed in Section 2.3, where no such property is given. I conclude that (59) does not properly capture the link between portrait and portrayed object. The adaption account, by contrast, captures this link by rendering the representation dependent on the portrayed object as such. One can add that, according to the property-based analysis, representations are introduced in the same way on i- and p-readings. This hardly seems to be compatible with their being discourse-transparent only on i-readings.

Third, examples with ordinary representational objects such as paint a portrait typically convey that the explicit object is the representation produced by the painting. The lexical entry in (55a) does not allow for its derivation, as the produced representation is bound existentially, while the explicit object relates to the property \(P\) it represents. This enforces a separate entry for these examples, which is neither economic nor consistent with the commonalities between i-readings of different flavors. This speaks in favor of a uniform treatment as provided by the adaption account.
In sum, a property-based approach to depiction verbs such as *paint* faces several serious problems. I conclude that it is not a feasible alternative to the proposed adaption analysis.

5. Conclusion and outlook

Combinations of depiction verbs such as *paint* with nominal objects based on nouns such as *cow* are ambiguous between *i*-(image)- and *p*-(portrait)-readings. *I*-readings involve representations that build on resemblance to corresponding ordinary objects in general. Contrary to first impressions, they are extensional (and in this respect analogous to *i*-readings based on representational nouns such as *portrait*): both weak and strong determiners license *i*-readings by quantifying over discourse-new and discourse-old representations in the world, respectively; correspondingly, anaphors to representations are licit. *P*-readings, by contrast, involve representations that depend on the portrayed ordinary objects as particulars. Here determiners quantify over ordinary objects in the world, while the produced representations are implicit and thus inaccessible to anaphors. I developed a type- logically inspired adaption account that builds on the interaction between two hypotheses. First, nouns such as *cow* presuppose the justification of disjoint types consisting of object type and object representation type. Second, depiction verbs such as *paint* license local coercion from objects to their representations. I argued that this adaption account captures the data considerably better than the property-based intensional alternative.

Finally, I would like to provide an outlook for two key issues worthy of closer scrutiny in future research. For one, the given proposal is well suited for an extension to rarely addressed constraints. For instance, *write* prohibits both *p* - and *i*-readings in combination with nouns such as *cow*, as shown by (60a). *I*-readings are only possible with adequate representational nouns, as in (60b).

(60)  
  a. #Ben wrote a cow.
  b. Ben wrote {a text about / a description of / a poem about} a cow.

The pattern is captured as follows. Representations provided by nouns such as *cow* are based on visual resemblance and thus are not of a propositional nature. Therefore, (60a) cannot receive an *i*-reading. The examples in (61) provide independent evidence for the constraint.

(61)  
  [Ben drew a cow and wrote a description of a cow.]
  a. Ben proudly showed his cow *picture* to his mother.
  b. #Ben proudly read his cow *description* to his mother.

Furthermore, *write* can be said to select a physically manifest informational object while lacking a polymorphic type licensing coercion to such objects; see the entry in (62).

(62) \[
\text{[write]} = \lambda \Psi \lambda z \lambda \pi. \Psi(\lambda y \lambda \pi'. \text{write}(z, y, \pi'))(\pi \ast \text{ARG}_{2}^{\text{write}}: \text{PHYS } \bullet \text{INFO})
\]

13For reasons of space, I have to defer a thorough comparison to the intensional analysis in Forbes (2006: 138–150) to another occasion. As far as I see, it is also at variance with the full range of extensional effects attested.
Hence, a p-reading is out for (60a) as well; there is simply no lexical anchor for the required coercion. (60b) is fine because the explicit nouns themselves provide the appropriate type.

The second key issue is more general. In its present form, the disjoint type hypothesis is agnostic to the question of whether object type and object representation type have an equal status or are ranked in a linguistically relevant way. For instance, it could be that the representation reading is systematically derived from the object reading and, thus, less readily accessible than its source. One way of approaching the relation between both readings is a thorough comparison to other types of (lexical) ambiguity; a particularly interesting candidate would be the generalized ambiguity between kinds and particulars. In any case, it is open to discussion what implications the proposed type disjunction has for the lexical system as a whole.

References


On acquiring a complex personal reference system: Experimental results from Thai children with autism

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Abstract. Reference of pronouns may be constrained via lexical presuppositions, including marked $\phi$-features, implicated presuppositions, and deictic center shifting in certain languages. This paper explores the acquisition of personal reference terms in Thai, a language that has a highly complex personal reference system. The participants of the study were 67 typically-developing children (TD) and 29 children with autism spectrum disorders (ASD), a population which has long been observed to have difficulties with pronouns. The children were asked to complete simple production and comprehension tasks on personal reference terms. Overall, ASD children performed on par in production but significantly poorer in comprehension than TD children. Given the freedom of choice in the production task, ASD children preferred using fixed referential terms for self-reference, whereas TD children opted for personal pronouns. In terms of comprehension, ASD children were shown to generally be able to detect the person features but they seemed to struggle the most with the pragmatic aspects of personal reference terms. Our results support previous literature that lexical presuppositions are acquired earlier than implicated presuppositions. We add to the literature that the types or the amount of implicated presuppositions matter in acquisition.

Keywords: implicated presupposition, pragmatic inference, pronoun, personal reference, acquisition, deixis, Thai

1. Introduction

While certain types of pragmatic inferences have been widely studied in the acquisition literature, implicated presuppositions have received much less attention, with some exceptions such as Yatsushiro (2008) and Legendre et al. (2011). Sauerland (2008b) adopted Heim’s (1991) MAXIMIZE PRESUPPOSITION maxim to explain the semantic markedness of $\phi$-features in pronouns. Since first and second persons possess a person $\phi$-feature, they trigger the lexical presuppositions, referring to the speaker and addressee/participant, respectively. The lack of such a $\phi$-feature on third person gives rise to an implicated presupposition that the referent is not the speaker nor the addressee/participant on this account. This study extends the contexts of pragmatically-derived inferences to the issue on deictic and person interpretations of pronouns in Thai, a language that is rich in personal reference terms and consists of not only over 50 personal pronouns, but also kin terms, occupational titles, and personal names (Bandhumedha 2011; Cooke 1968; Iwasaki and Ingkapirom 2009). The populations under examination include both typically-developing children (TD) and children with autism spectrum disorders (ASD),
a population group which has long been observed to have difficulties with pronouns, such as
pronoun reversal errors between ‘I’ and ‘you’ in English (Chiat 1982; Fay 1979).

The present paper begins with two main topics for the background literature on the semantics
and pragmatics of pronouns (§2) and on pronouns and autism (§3). Section 4 presents the
methods of the study. Results of the experiment are described in Section 5 and discussed in 6.
Section 7 concludes.

2. Semantics and pragmatics of pronouns

Distinctions between personal pronouns can be made along various dimensions. In the person
dimension, the 1st and 2nd persons are cross-linguistically observed to be different from the
3rd person in various ways, such as their associative plural generalization (See Greenberg 1988;
Noyer 1992; Cysouw 2003.) and their bound interpretations (See Heim 1994; Kratzer 2009;
Sudo 2012, etc.). While the 1st and 2nd persons are generally defined as referring to the
speaker and the hearer respectively, the 3rd person is described as referring to neither (Lyons
1977). This fact led to different proposed sets of features for 1st and 2nd person versus 3rd
person pronouns. Sauerland (2008b) proposed that the 3rd person is the most unmarked among
the three persons. The verb agreements in Czech (1) is an example of how the 1st and 2nd
persons dominate the 3rd person. Further similar evidence was presented in Sauerland (2008b)
to support that the 1st person is more marked than the 2nd person as seen in their dominance
relationship, e.g., in English (2) and in German (3).

(1) a. bratr a já se učíme hrát na klavír
   brother and 1.SG self.acc teach-1PL play on piano
   ‘My brother and I are learning to play the piano.’

   b. tvůj otec a ty jste si podobní
   your father and you be.2PL self.DAT alike
   ‘Your father and you are alike.’

   (Corbett 1991, pp. 262)

(2) You and I, we, are special. (Sauerland 2008b, pp. 26)

(3) Du und ich sind/#seid etwas besonderes.
   you and I be.1/3PL/#be.2PL something special
   ‘You and I are something special.’

   (Corbett 1991, pp. 262)

For languages without inclusive/exclusive distinctions, e.g., English, Sauerland (2008b) pro-
posed that the 1st person has the most marked feature specifications, containing [participant]
and [speaker]. The specification for the 2nd person is only [participant]. For languages with in-
clusive/exclusive distinctions, including Thai\(^2\), Sauerland (2008b) proposed the features [speaker]

\(^2\)Cysouw (2013), basing on the data from Noss (1964), did not list Thai as a language with inclusive/exclusive
distinctions. Instead, Cysouw (2013) listed Thai as another category having identical ‘we’ and ‘I’. While this may
be true for the pronoun raw, which can mean both, it is not representative of the entire Thai personal reference
system. The forms /raw/ or, with the plural marker, p\(^b\)ták-raw have no inclusive/exclusive distinctions, just like
English ‘we’. However, in Thai, there are also other pronouns that can only mean ‘I’ and not ‘we’, such as c’h\(\ä\)n.
Combining this pronoun with the plural marker for pronouns forms p\(^b\)ták-c’h\(\ä\)n which means ‘I and some others,
but not you’. This is comparable to w\(\öm\)en in Mandarin, which was listed as a language with these distinctions.
and [addressee] instead, leaving exclusive 1st person pronouns and 2nd person pronouns undetermined on their rank on markedness scale. In both types of languages, however, the 3rd person lacks a person \( \phi \)-feature altogether.\(^3\) The lexical presupposition is, thus, not triggered by the 3rd person. This is where Sauerland (2008b) adopted Heim’s (1991) MAXIMIZE PRESUP-POSITION maxim, suggesting that the form with the strongest lexical presupposition must be chosen whenever its presupposition is felicitous. In other words, the use of 3rd person pronouns gives rise to another kind of presupposition: an ‘implicated presupposition’ (Sauerland, 2003, 2008a, b) that the pronouns do not refer to either of the participants. Otherwise, according to the maxim, the 1st or 2nd person pronouns would have been used. In sum, instead of having a lexical presupposition for the features [speaker] or [addressee], the 3rd person only has an implicated presupposition of being ‘anti-participant’.

Apart from the person dimension, pronouns may contain other descriptive features, such as, gender and number in English, to denote the properties of the referred individual. The relevant descriptive feature for this paper is gender. Sauerland (2008b) proposed that among all the languages with masculine/feminine distinctions in pronouns, the feminine distinction is cross-linguistically more marked than the masculine. This can be seen in the dominance of the masculine gender over the feminine gender on agreement, e.g., in French (4) and Czech (5). In contrast, the human/non-human gender distinction varies in its markedness across languages. For instance, in Luganda, although not fully acceptable in all circumstances, the gender class 8 which agrees with non-human subjects is preferred over, i.e., dominate, the gender class 2 for human, when the subject consists of a mixed group of humans and non-humans (6). While it seems that the non-human gender in Luganda and other languages, especially the Bantu languages, is more marked than the human gender, there are languages, e.g., Tamil (Corbett, 1991), which has a reversed dominance relationship between human/non-human genders.

(4) un \( \text{père et une mère excellent-}\)excellent-s
\(\text{a.MASC father and a.FEM mother}\) excellent-MASC.PL
‘an excellent father and mother’

(5) Jan a Věra \(\text{šl-i do biografu}\)
\(\text{Jan and Vera go-PST-}\)PST-MASC.PL to movies
‘Jan and Vera went to the movies.’

(6) a. ? omu-sajja ne \(\text{em-bwa-ye bi-agwa}\)
\(\text{1-man and 9-dog-his}\) fall-PST
‘The man and his dog fell down.’

b. * omu-sajja ne \(\text{em-bwa-ye ba-agwa}\)
\(\text{1-man and 9-dog-his}\) fall-PST
‘The man and his dog fell down.’

In this paper, we assume that Thai is a language with inclusive/exclusive distinctions. Certain pronouns, such as raw, might be underspecified for the feature [addressee], resulting in the seeming lack of such distinctions.\(^3\) Kratzer (2009) had a similar proposal that 1st and 2nd person pronouns contain the features [1st] and [2nd] respectively, while 3rd person pronouns only contain the feature [def] as they merely are definite descriptions, i.e., containing no inherent meanings as other persons. The difference in their proposal is that the features [1st] and [2nd] in Kratzer’s (2009) proposal pick out an individual, while Sauerland’s (2008b) person features are of the type \(<e,t>\). To avoid unnecessary complications, Sauerland’s system is employed throughout the paper.
Although Sauerland (2008b) proposed that the [female] gender is crosslinguistically marked, we argue that the fact only holds true in 3rd person. In Thai, there are masculine/feminine distinctions in 1st and 2nd person pronouns as well. The epistemic status of male pronouns is restricted such that the referred individuals must only be male, while that of female ones does not. Therefore, we argued that for 1st and 2nd persons in Thai, the feature [male] is marked, while for 3rd person, the feature [female] is marked.

As mentioned above, human/non-human gender distinctions vary across languages. Two markedness tests, namely the dominance test and the epistemic status test, were then applied to Thai 3rd person pronouns. The coordination of a human and a non-human subject in (7) shows the dominance of the non-human gender. The ‘it’-equivalent pronoun man is chosen to be a resumptive pronoun for the entire coordination. Note that when this pronoun is used to refer to a person, it is implied that the speaker does not respect him/her. The 3rd person human pronoun khéaw, on the other hand, cannot be used to refer to a coordination where one of the components is non-human. The epistemic status test in (8) confirms that the non-human gender is less marked as reference to a human is not ruled out as impossible by the use of the pronoun man. It is then concluded that the [human] feature in Thai is marked, while the [non-human] feature is not, giving rise to an implicated presupposition.

   owner and dog 3.HUM walk DEI together
b. cǎw-khá:w ká:p mà: man dý:n ma: dúaj-kan  
   owner and dog 3.NH walk DEI together
   ‘The owner and the dog walked (towards the speaker) together.’
   dog and owner 3.HUM walk DEI together
d. mà: ká:p cǎw-khá:w man dý:n ma: dúaj-kan  
   dog and owner 3.NH walk DEI together
   ‘The dog and the owner walked (towards the speaker) together.’

(8) a. man kam-laŋ kin khá:w jú:  
   3.NH PROG eat rice PROG
   ‘It is having a meal.’
   i) ✓ referring to an animal  ii) ✓ referring to a person
b. khá:w kam-laŋ kin khá:w jú:  
   3.HUM PROG eat rice PROG
   ‘He/she is having a meal.’
   i) * referring to an animal  ii) ✓ referring to a person

With regards to the traditional taxonomy, personal pronouns may be inherently deictic, meaning that they have varied referents depending on the extralinguistic contexts of who the speakers and the addressees are in a particular speech event. This property is referred to as ‘person deixis’, a subtype of a broader term ‘deixis’, which covers a range of references that varies by the context of an utterance based on certain important elements: person (e.g., ‘I’ and ‘you’), time (e.g., ‘now’ and ‘later’), place (e.g., ‘here’ and ‘there’), discourse (e.g., ‘this’ and ‘that’),
and social (e.g., honorifics) (Fillmore 1971, 1975; Lyons 1977; Levinson 1984). In addition to involving person deixis, personal pronouns may also be socially deictic, i.e., the choice of a pronoun points to the social status of the participants in the context. This aspect is closely related to their politeness distinctions. Typologically, second person pronouns in 71 languages out of 207 investigated languages encode politeness distinctions in some way (Helmbrecht, 2013). Among these languages, 49 of them encode a binary politeness distinction (e.g., German du/Sie, Russian ty/vy, French tu/vous, etc.), while 15 encode multiple politeness distinctions (e.g., Marathi). The rarest type of politeness distinctions, found in merely 7 languages, is when second person pronouns are avoided for politeness. These languages are all spoken in East and Southeast Asia, including, Burmese, Indonesian, Japanese, Khmer, Korean, Thai, and Vietnamese. Southeast Asian languages, instead, employ other kinds of personal reference terms to politely address the hearer.

This paper focuses on Thai, a language with a highly complex personal reference system. Personal reference system in Thai involves not only personal pronouns, but also kin terms, occupational titles, and personal names (Bandhumedha 2011; Iwasaki and Ingkapirom 2009, among others). According to the list by Cooke (1968), personal pronouns alone comprise 27 first-person pronouns, 22 second-person pronouns, and 8 third-person pronouns. The other three categories combined consist of countless items. Choosing pronouns among these abundant choices requires considering different factors, such as age, sex, societal status. Kin terms, for instance, can be used in an amicable fashion to refer to people outside of one’s family, depending on the referent’s age and relationship with the speaker.

Certain personal reference terms in Thai can refer to more than one person with different pragmatic effects. For instance, in child-directed speech, a female adult can use the male first-person pronoun phin to refer to the hearer who is a boy. This reverses the values between speakers and hearers and the relationship between them; instead of the speaker being male, the hearer is male. This kind of person syncretism is derived from deictic-center shifting. This does not only reverse the values of features between the speaker and the hearer but also the change in the deictic center as seen in abundant cases of other terms in Thai. For example, talking to their younger child, parents can refer to their older child as phii: ‘older sibling’. This is a case where parents shift the deictic center to their younger child who would refer to their older child using that term. Had the parents themselves been the deictic center, the older child would be referred to as lik ‘child’. Since such use of personal reference terms involves stylistic usages, this paper assumes that for certain terms where deictic-center shifting is possible, their features are not underspecified nor unmarked. We, therefore, claim that their meaning is not derived through an implicated presupposition.

The acquisition of implicated presuppositions and pronouns. The acquisition of implicated presuppositions has received much less attention than other pragmatic inferences, with some exceptions such as Yatsushiro (2008) and Legendre et al. (2011). Yatsushiro (2008) investigated the acquisition of lexical presupposition, implicated presupposition, and scalar implicature. She examined the German universal quantifier jeder ‘every’, which both lexically presupposes existence and implicates a presupposition of anti-uniqueness. Consider the sentences in (9):

\[
\text{Since the definite determiner the lexically presupposes both existence and uniqueness, its use}
\]
is felicitous. On the other hand, the universal quantifier every has an implicated presupposition of anti-uniqueness. Our encyclopedic knowledge that one can only have one biological father makes the sentence infelicitous.

\[(9)\]
\[\begin{align*}
&\text{a. } \text{I interviewed every biological father of the victim.} \\
&\text{b. } \text{I interviewed the biological father of the victim.} \quad \text{(Yatsushiro 2008, pp. 667)}
\end{align*}\]

Yatsushiro (2008) conducted an experiment with 120 German-speaking children and 21 adult controls. The task is to choose the felicitous sentence(s) from a choice of two sentences for describing the picture that is shown. For instance, sentences in (10) were presented as choices for describing the picture of a girl playing soccer.

\[(10)\]
\[\begin{align*}
&\text{a. } \text{Das Mädchen hier spielt Fussball} \\
&\text{the girl here plays soccer} \\
&\text{‘The girl here is playing soccer.’} \\
&\text{b. } \text{Jedes Mädchen hier spielt Fussball} \\
&\text{every girl here plays soccer} \\
&\text{‘Every girl here is playing soccer.’} \quad \text{(Yatsushiro 2008, pp. 671)}
\end{align*}\]

The results show that 6-year-old children accepted (10b) significantly more than other groups of children and adults. This suggests that they have acquired lexical presuppositions, but have not fully acquired implicated presuppositions of anti-uniqueness. Yatsushiro (2008) then argued that implicated presuppositions are acquired later than lexical presuppositions, while having their acquisition path of implicated more similar to that of scalar implicatures.

Legendre et al. (2011) examined the acquisition of pronouns in French by testing the comprehension of 3 singular and 3 plural French pronouns by sixteen 30-month-old toddlers. They found that the comprehension of 3rd person elle was at chance level, in contrast with a good performance on 1st person je and 2nd person tu. All the plural pronouns seem to yield below-chance performance across all persons. They concluded that the results support Heim’s (1991) theory on presuppositions and Sauerland’s (2008b) markedness scale. The result is also in accordance with Yatsushiro’s (2008) claim that implicated presuppositions are acquired later than lexical presuppositions.

3. Pronouns and autism

Autism spectrum disorders (ASD) are characterized with three core features: social deficits, language and communication deficits, and repetitive behaviors (American Psychiatric Association 2000). Since language abilities among children with autism are largely heterogenous, researchers have divided them into autism with language impairment (ALI) and autism with normal or above average linguistic abilities (ALN) (Boucher 2012; Kjelgaard and Tager-Flusberg 2001; Rapin et al. 2009; Tager-Flusberg 2006; Whitehouse et al. 2008; Williams et al. 2008). It is still unclear, however, what the pattern of language impairments in the ALI subgroup is.
Pragmatics and discourse are generally accepted in the autism literature to be central to language deficits in autism (for reviews, see Lord and Paul 1997; Tager-Flusberg 1999; Wilkinson 1998). More recent studies (e.g., Eigsti et al. 2011; Tager-Flusberg and Joseph 2003) have found more fundamental impairments in other areas of language. Current hypotheses (See Walenski et al. 2006; Boucher 2012; Boucher et al. 2008) propose that the grammatical domains of language are impaired in ASD, while the lexical domains are still intact. Further research on language and autism is needed to support or challenge such a claim.

Among pragmatic deficits, difficulties in personal pronoun use have been observed since the beginning of the study of autism by Kanner (1943). Such difficulties with pronouns in ASD were also reported in many of the later studies (see, for instance, Bartak and Rutter 1974; Charney 1980; Chiat 1982; Fay 1979; Loveland 1984). Recent work by Mizuno et al. (2011) explored the neural basis of the personal pronouns *I* and *you*, in comparison with names which denote fixed identity in adults with high-functioning autism. The results show slower and less accurate responses when the task involves personal pronouns rather than names. Moreover, for questions containing the second person pronoun, this study detected an underconnectivity between right anterior insula, primarily involved in self-awareness and self-consciousness, and precuneus, essentially involved in spatial attention. The underconnectivity did not, however, appear with the questions containing first person pronouns.

Interestingly, errors in pronoun usage in autism are not restricted to deixis and the reversal of person features (11), but also involve errors in case markings (12). This leads to further questions on where the difficulties actually lie when it comes to the processing of pronouns in autism.

(11) a. “You want candy.”
     b. “Hurt yourself.”
     c. “Help you please.”  

(Tager-Flusberg 1994, pp. 185)

(12) a. “My get it.”
     b. “Me cool off.”
     c. “Do down me arm.”

(Tager-Flusberg 1994, pp. 184-5)

As for Thai personal reference terms and autism, Chanchaochai (2013) observed three children with ASD over a three-month period and found that personal reference terms with lower deitic level, including kin terms, occupational titles, and personal names, were preferred over the ones with higher deitic levels like pronouns. Person deixis avoidance is thus another phenomenon that may play a role in the production of Thai personal reference terms in autism.

This project investigates the performance in both production and comprehension of a subset of common Thai personal reference terms. The goal is to compare between the two groups of participants, ASD and TD, and also between different groups of personal reference terms. The main differences within the personal reference terms include person and gender $\phi$-features, deictic level, and deictic-center shifting.
4. Methods

4.1. Participants

Children with ASD ($N=29$; Male $N=24$; Age Range = 6;7-12;2 $M=9;10\ SD=21.56$) and their age-, gender-, and non-verbal-IQ (NVIQ) matched TD controls$^3$ ($N=67$; Male $N=55$; Age Range = 6;1-12;8 $M=9\ SD=21.42$) were recruited from (1) Kasetsart University Laboratory School, Center for Educational Research and Development and (2) La-or Utis Demonstration School. One ASD participant was classified in his medical records as having Pervasive Developmental Disorder-Not Otherwise Specified (PDD-NOS), while the remaining are all classified as having Autistic Disorder (AD). The Ravens Standardized Progressive Matrices (Raven et al. 2000) were administered to both groups of participants for the assessment of NVIQ (ASD $M=97.8\ SD=22.24$; TD $M=112.95\ SD=15.46$). The scores were converted using the norms in the 1979 British Standardisation of the Standard Progressive Matrices (Raven 2000, pp. 39-40). Children in both groups had normal hearing and normal or corrected-to-normal vision. This study was approved by the Institutional Review Board at the University of Pennsylvania. Having been informed about the study and their rights, the parents of all the participants provided written consent for their child to participate in the study.

4.2. Materials

The main design of the experiment adapts the Fishing Task (Girouard et al. 1997; Legendre et al. 2011). The speech context comprises five participants, including the experimenter (E), the child (C; tested individually), and 20-inch-tall cardboard figures of a boy (B), a girl (G), and a monkey (M; See Figure 1.). The blank space, which each of the cardboard figures are holding, was left for attaching 58 cards with the pictures of different objects using a reusable adhesive.

![Figure 1: Extra participants in the experiment](image)

$^4$We attempted to subgroup the TD children into the age-matched group and the NVIQ-matched group. However, the results from different ways of subgrouping remain very similar to those from the entire group. Therefore, this paper only presents the data from the entire group of the TD children.
4.2.1. Tested personal reference terms

For the comprehension task, all of the personal reference terms that are applicable to the context of our experiment were chosen. The test phase included 8 personal reference terms: 1 first-person, 4 second-persons (3 pronouns for each child depending on the child’s gender, i.e., nū: for girls and pʰōm for boys as highlighted in Table 1), and 3 third-persons. The selected terms are personal pronouns, except for two terms: pʰiː: ‘older sibling’ and nōy ‘younger sibling’, which are kin terms. The order of pronouns in question was pseudo-randomized such that the possible answers of each phase do not refer to all the speech participants, so that they do not leave later referents predictable. The randomization methods make the amount of trials per each pronoun different. Each targeted pronoun was, however, repeated at least twice.

Based on the literature discussed in Section 2, below we provide tentative semantic denotations for the personal reference terms that were used in the experiment in Table 1. The denotations of each pronoun are merely semi-formal so as to clearly illustrate their possible feature bundles to the readers. This table summarizes all the possible denotations of each personal reference term whose target is restricted to only one referent by the context of the experiment. For instance, the first term in the table pʰiː: ‘older sibling’ can be used to refer to either the speaker or the addressee as long as the referent is the older one in the situation. Therefore, in the setting of this experiment, when I, the experimenter, used this term to talk to a child, this term always referred to me, the older participant. Likewise, if the child used this term in this situation, it would still refer to me, the older experimenter. This is different from the pronouns pʰōm and tʰyː, which have more complex dimensions while being used as different persons. In Section 2, we proposed that deictic-center shifting does not involve unmarked person features. Thus, even though the pronoun pʰōm is technically a 1st-person pronoun for men of any age, it is also marked with 2nd as a separate entity since it can be used only in child-directed speech, where deictic-center shifting is employed. As for the pronoun tʰyː, it is generally a 2nd-person pronoun when the addressee is of an equivalent age or social status. The addressee can be younger or in a lower social status as well but that is only used in an unfriendly and distant (almost degrading) sense. Since the experimenter is not the children’s peer and also ended each sentence with a polite final particle, the 2nd person reading should not be applicable in this context.

4.3. Procedure

In the beginning of each block, the children were first asked to name pictures of commonly known animals and objects. The pictures were then distributed across participants. Before the production task, no pronouns were used so to avoid priming the children. In the test phase, each participant in the production task or each term in the comprehension task was randomly selected to be a target, and its reduced form kʰáw (more frequently used) are underspecified for gender. Only the full form was tested.
Table 1: Tested personal reference terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Person</th>
<th>Gender</th>
<th>Social-deictic</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>φi:</td>
<td>participant</td>
<td>{1st, 2nd}</td>
<td>-</td>
<td>older sibling</td>
</tr>
<tr>
<td>nü:</td>
<td>participant</td>
<td>{1st, 2nd}</td>
<td>-</td>
<td>younger sibling</td>
</tr>
<tr>
<td>þóm</td>
<td>speaker</td>
<td>{1st}</td>
<td>male</td>
<td>-</td>
</tr>
<tr>
<td>þun</td>
<td>addressee</td>
<td>{2nd}</td>
<td>male</td>
<td>-</td>
</tr>
<tr>
<td>n̄o:</td>
<td>participant</td>
<td>{1st, 2nd}</td>
<td>-</td>
<td>younger sibling</td>
</tr>
</tbody>
</table>

Antiparticipant

<table>
<thead>
<tr>
<th>Term</th>
<th>Person</th>
<th>Gender</th>
<th>Social-deictic</th>
<th>Implicated Presup Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>khāw</td>
<td>-</td>
<td>human</td>
<td>anti-participant, non-feminine</td>
<td>B</td>
</tr>
<tr>
<td>th:`</td>
<td>addressee</td>
<td>{2nd}</td>
<td>peer human, female</td>
<td>anti-participant</td>
</tr>
<tr>
<td>man</td>
<td>-</td>
<td>human, female</td>
<td>anti-participant, non-human</td>
<td>M</td>
</tr>
</tbody>
</table>

selected as the expected target at least twice. A different set of 5 objects was changed after every 3 trials. Below are the instructions in the order as they appeared in the experiment.

**Preparatory Phase:**

E: ‘What’s (your) name?’
E: ‘What is this?’ (Repeat for 5 objects per block.)

**Production Task:**

**TEST PHASE:**

E: ‘Who is holding X?’ (Twice for each target.)
C: ‘... (is holding X.)’

**Comprehension Task:**

**FAMILIARIZATION PHASE:**

E: ‘What is Y{the boy/girl/monkey/child’s name} holding?’
C: ‘(Y is holding) X.’

**TEST PHASE:**

E: ‘What is Y{tested pronoun} holding?’
C: ‘(Y is holding) ...’

7Thai is a pro-drop language so pronouns can be avoided here.
5. Results

5.1. Overall accuracy

One ASD child was withdrawn from the experiment because he did not answer to any of the questions. His results were excluded from the calculations. An answer was marked as accurate when it referred to the right referent. The accuracy rate for production is near ceiling for both the ASD (94.6%) and the TD (90.6%) groups with ASD children performing significantly more accurately (Mann-Whitney \(U=97595, p=0.04\)). The accuracy rate for comprehension dropped for both groups (60.4% for ASD; 82.3% for TD) with a much sharper drop for ASD (Figure 2). The comprehension task accuracy thus yields a highly significant difference between participant groups (Mann-Whitney \(U=658640, p<0.001\)).

![Figure 2: Overall accuracy across tasks](image)

![Figure 3: Choices of terms the children used to refer to themselves](image)

5.2. Production

The most common personal reference terms that the children in both groups used to refer to themselves are personal names and personal pronouns. However, they were found in a reversed preferred pattern (Figure 3). In the ASD group, personal names were used 57.4% of the time versus 25.9% for personal pronouns, compared to 15.7% versus 75.2%, respectively, for the TD group. The proportion of counts for the two most commonly-chosen categories for self-reference showed a very significant difference across participant groups (Fisher’s Exact, \(p<0.001\)).

As for the reference to the experimenter, children with ASD used the occupational title \(k^{h}ru\): ‘teacher’ to refer to the experimenter the most (51.95%), followed by the use of kin term \(p^{h}i\): ‘older sibling’ (42.3%). TD children, on the other hand, preferred the kin term (55%), over the occupational title (44.15%). However, the proportion of the choices for referring to the experimenter was not significantly different across groups (Fisher’s Exact, \(p=0.23\)). As for the reference to the cardboard figures, both of the groups mainly used common nouns (boy, girl, monkey) to refer to them (92.1% for ASD; 97.1% for TD). Thus, the two participant groups are not significantly different from each other (Fisher’s Exact, \(p=0.19\)).
5.3. Comprehension

Overall, third person yields the poorest performance for the ASD group (See Figure 4). As for the TD group, only the male third person yields poorer performance among the third persons. The only form where ASD children outperformed TD children is the formal second-person pronoun $k^nun$ with a non-ambiguous referent. A fixed effect logistic regression model ($\text{Accuracy} \sim \text{Group} + \text{Gender} + z\text{Age} + z\text{NVIQ}$) was run on the comprehension task. It reveals that the accuracy is significantly different across participant groups ($z=10.736, p<0.001$), age ($z=12.294, p<0.001$), and NVIQ ($z=10.167, p<0.001$). The gender of the participants is not a significant factor for their performance ($z=-0.015, p=0.99$).

![Figure 4: Accuracy in comprehension task by item](image)

5.3.1. Error analysis

This section explores the pattern of errors in the comprehension task. Figure 5 shows the percentages of errors among all trials. This is to examine the choices the children opted for, instead of the expected referents.

**Experimenter-Targeted:** Instead of choosing the experimenter as the target for the pronoun $p^niti$ ‘older sibling’, a subgroup of both ASD and TD children mistook the term for referring to the cardboard figures (Figure 5a). The ASD children made more mistakes answering that they themselves were the referent to the term ‘older sibling’, while in fact, they were not older (ASD 8%; TD 1.5%).

**Child-Targeted:** A similar pattern was observed in the comprehension of the term $n\dot{\theta}yu$ ‘younger...
sibling’ where the children chose the cardboard figures as the referent, instead of choosing themselves (Figure 5e). Some ASD children also chose the experimenter as the referent for the terms นี่: (1st/2nd younger female) (10%; Figure 5b), ผู้ชาย: (1st male deictic-center shifted) (8.7%; Figure 5c), คุณ (2nd formal) (1.8%; Figure 5d), and น้อง ’younger sibling’ (1.8%; Figure 5e). As for the TD children, regardless of the number of errors they made in the comprehension of the formal second person pronoun คุณ, the experimenter was never one of the wrong targets for any of the tested second person pronouns.

Figure 5: Errors in comprehension task by item

**Boy-Targeted:** The majority of mistakes made by both ASD and TD was related to gender, where they chose the cardboard girl figure instead (ASD 25.9%; TD 20.5%). With regards to the person feature, the ASD children chose more non-third-person targets than the TD group (24.1% versus 6%; see Figure 5f).

**Girl-Targeted:** The pronoun used for targeting the girl is ย์: As noted earlier, this pronoun is generally used to refer to a second person, with underspecified gender. Although the usage as a second person is very common, it is only used among people of the same age or status.
It is highly likely that the participants were referred to by their peers using this pronoun. If the speaker of the pronoun is an older person, the addressee and the speaker must be close to each other (stylistic use), otherwise, the term would sound very unfriendly and pragmatically inappropriate. The results seem to show that the sensitivity to this social dimension of the pronoun was largely ignored by the ASD children, choosing themselves as the target 31% of the time (Figure 5g).

**Monkey-Targeted:** The errors for *man* covered all four other choices (Figure 5h). The ASD children made mistakes with regards to person features, choosing the experimenter or themselves (11.1% and 7.1%, respectively) at a much higher rate than the TD children (0.6% and 1.6%).

### 6. Discussion

Not only do the results present many interesting aspects of the data, but they also show a coherent picture of the acquisition pattern of personal reference terms in TD and ASD children. The performance on production and comprehension was asymmetrical in both participant groups, with the ASD children performing significantly poorer than the TD children in the comprehension tasks, regardless of their significantly more accurate production. Lexical presuppositions seemed to be easier to comprehend than implicated presuppositions for both groups of children as well. Even though their overall accuracy is lower than TD children, ASD children are, to a large extent, able to comprehend the second person lexical presupposition suggested by the person \( p \)-feature, when the person feature is not underspecified. This was suggested by the fact that \( \text{ku} \) (2nd formal) is the only pronoun which the ASD group outperformed the TD group. The TD group’s performance, on the other hand, seems to be suppressed by the social awkwardness of using the formal pronoun to refer to a child, while the ASD children solely paid attention to the person \( p \)-feature as they largely ignored the social deictic dimension of the formal second-person pronouns.

A similar result was found in the errors in the comprehension of the pronoun \( \text{tu} \), targeting the cardboard girl figure. The ASD children made significantly more mistakes than the TD children even though the [female] feature is marked, suggesting that person \( p \)-features are the most prominent cue for them, not gender or social descriptive features. This is in accordance with the overall results that the ASD children could correctly detect the marked person feature of a pronoun, instead of the unmarked 3rd person, but failed to take into account the social descriptive features (that the term is mostly used among peers) or to recognize the social relationship in a particular context (that the experimenter is not his/her peer).

However, given the freedom of production, ASD children avoid person deixis by choosing fixed referential terms (names) rather than terms with a higher level of person deixis (i.e., pronouns) to refer to themselves. To refer to the experimenter, both of the groups mainly chose to use either kin terms or occupational titles. Recall that Thai is among the seven languages that omit 2nd person pronouns for politeness. If a relationship between the speaker and the addressee is known, the term denoting that relationship, rather than a 2nd person pronoun, should be used. As for the terms used for cardboard figures, children in both groups chose to use common
nouns, rather than any personal reference terms. This can be explained by the fact that the use of pronouns also presupposes salience (Roberts 2004). The children preferred the full form over the pronouns because the referent was not salient or not as salient as other possible referents in the context. If the experiment had been conducted in English, the same results should still be expected, as can be seen in the examples below where a weakly familiar referent does not guarantee salience (13). It is, therefore, not possible to conclude that the choice of less deictic terms for the 2nd and 3rd person referents in the experiment is the case of person deixis avoidance or not.

(13)  a. *In Amsterdam, if a bicyclist isn’t very careful, it’ll be stolen.
    b. In Amsterdam, if a bicyclist isn’t very careful, her bicycle will be stolen.

(Roberts 2004, pp. 517)

Regardless of the fact, the choice for the 2nd person across the participant groups still yielded interesting results. Although the proportion of the choice between kin terms and occupational titles by the ASD group and the TD group is not statistically significant, the ASD group preferred to use more occupational titles than kin terms. It is worth noting that kin terms and occupational titles contain different levels of social deixis. The use of occupational titles is more fixed. It is possible to refer to someone using occupational titles even though the terms are not applicable to one’s relationship with that person. For instance, the owner of a restaurant near a school may refer to his/her customer using the term ‘teacher’ without having to be the student of that person if he/she knows the customer’s occupation. This is in contrast with kin terms which could vary by age and relationship between the speaker and the addressee.

In terms of implicated presuppositions across populations, challenges arise in the resolution of implicated presuppositions when certain $\phi$-features are unspecified. For the ASD group, person unmarkedness alone could decrease their performance, as can be seen in the lower performance in all the third-person forms. The further pragmatic inference that has to be made for gender unmarkedness of male pronouns had an additive decreasing effect for the ASD group. The implicated presupposition from the unmarked non-human feature seemed to be easier than that from the unmarked masculine feature across participant groups. The TD group’s performance was only affected in male third-person pronouns, but not any other third-person forms. This suggests either that the TD group may only be affected when two implicated presuppositions (from person and gender unmarkedness) appear simultaneously or that the gender unmarkedness is particularly difficult for them. Such performance on different kinds of implicated presuppositions and deixis might correspond to the order of acquisition.

As for the case where adult native speakers of Thai seem to, prima facie, reverse ‘I’ and ‘you’ while talking to young children, pronouns with deictic-center shifting seemed to yield results similar to those with unmarked person features as kin terms and other 1st and 2nd person pronouns. This supports our hypothesis that person syncretism as a result of deictic-center shifting is not the same as the one which involves person underspecification.
7. Concluding remarks

In terms of types of presuppositions as proposed by Heim (1991), our results support Yatsushiro (2008) and Legendre et al. (2011) that lexical presuppositions are acquired earlier than implicated presuppositions. We add to the literature that the types or the amount of implicated presuppositions matter in the acquisition. The implicated presuppositions of non-human seemed to be relatively easier than those of masculine gender for children in both groups. The evidence lies in the lowest performance by both groups on the 3rd person male pronouns, which lack both their person $\phi$-feature and their masculine gender feature. With regards to the difference between the two groups of participants, the ASD children avoided terms with higher person deictic level when they had free choice in production. In general, the TD children made fewer and different types of errors than the ASD children. The ASD children were shown to generally be able to detect the person features, but they seemed to struggle the most with the pragmatic aspects of personal reference terms that involve implicated presuppositions and person and social deixis. A smaller group of the ASD children had difficulties with marked $\phi$-features, resulting in the pronoun-reversal type of errors. These grammatical mistakes with regards to $\phi$-features may hint on more fundamental language deficits. ASD children who made such mistakes after a certain age may belong to the ALI subgroup.

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Context updates in head-final languages: Linear order or hierarchy?¹
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Abstract. This paper argues that extant approaches to presupposition projection that either rely on strict linear order (Schlenker, 2009) or hierarchy (Romoli and Mandelkern, 2017) cannot provide a uniform account of data drawn from head-final languages. While building on Schlenker’s theory, this paper resolves the issues by restricting the calculation of local contexts to specific points in the parsing process. The consequence is that the theory makes a prediction robust to the head directionality parameter.

Keywords: presupposition projection, local context, parsing, linear order, hierarchy.

1. Introduction

Schlenker (2009, 2010, 2011a, 2011b) proposes a parsing-based account of presupposition projection that derives the local context of an expression on the basis of classical truth-conditional semantics. Schlenker argues that there is a pragmatic requirement that a presupposition must be entailed by a local context calculated according to the following definition:

(1) Local context (Schlenker 2011, incremental version)

The local context of an expression $d$ of propositional or predicative type which occurs in a syntactic environment $a \cdot b$ in a context $C$ is the strongest proposition or property $x$ which guarantees that for any expression $d'$ of the same type as $d$, for all strings $b'$ for which $a \cdot d' \cdot b'$ is a well-formed sentence,

$$C \models c' \rightarrow x \ a \ (c' \ and \ d') \ b' \leftrightarrow a \ d' \ b'$$

The key aspect of Schlenker’s theory is that local context is calculated incrementally: the interpreter traverses a string of expressions from left to right. Upon encountering $E$, it only has access to the expressions that linearly precede $E$. Given those expressions, the interpreter calculates the strongest but innocuous restriction. This left-to-right bias is built into the formulation of local context. In (1), the interpreter is completely agnostic to what follows the expression the local context of which is to be calculated ($b'$ in this case). Thus, it needs to take into account every possible continuation of the sequence $a \ d'$ that results in a well-formed sentence.

Schlenker claims that his theory of local contexts achieves explanatory adequacy in the sense that it predicts how presuppositions project based on syntax and classical truth-conditional semantics. On the other hand, extant dynamic approaches (Stalnaker, 1974; Heim, 1983) fail to do so because they encode such behavior in the lexical specification of words. For instance, Heim specifies ‘Context Change Potentials’ in the semantics of operators so that they can update the context in a specific order. However, as Schlenker points out, such a system would be

¹I would like to thank Philippe Schlenker for guiding me through the beautiful world of presuppositions. I would also like to thank Chris Barker, Jacopo Romoli, Masha Esipova, and Robert Pasternak for the discussions we had during the development of this work. I thank the anonymous SuB 22 reviewers and the audiences for their extremely helpful comments. All remaining errors are my own.
too strong to be sufficiently explanatory because one can encode an arbitrary update behavior to any given operator. For instance, one can come up with a deviant conjunction \( \text{and}^* \) which updates the context in the opposite order of ordinary conjunction \( \text{and} \). The dynamic approaches in principle cannot rule out this possibility.

While maintaining Schlenker’s view that presupposition projection behavior is closely related to the left-to-right bias inherent in parsing, this paper points out that local contexts cannot be calculated in a strictly incremental fashion. Evidence comes from head-final languages where predicates typically follow their arguments. An alternative parsing-based solution is to apply the algorithm to syntactic trees (Romoli and Mandelkern, 2017). It will be shown that the hierarchy-based account has difficulties explaining the presupposition projection behavior of coordinated structures.

I suggest that Schlenker’s algorithm should not be run word-by-word, but rather domain-by-domain, possibly postponing the computation of local context. The proposed analysis resolves the problems encountered in Schlenker’s original algorithm and the hierarchy-based account, while reproducing the correct predictions.

2. Issues in the linear order-based approach

2.1. Attitude context

Let’s first take a look at an English example in which a presupposition trigger is embedded under an attitude verb, and see how the incremental version of Schlenker’s algorithm makes the right prediction. In (2), the attitude verb \( \text{believes} \) embeds the presupposition trigger \( \text{continues} \).

(2) John believes that Mary smoked in high school, and he believes that she continues to smoke.

According to the incremental version of Schlenker’s algorithm, the target expression and whatever follows it cannot be foreseen. It must be the strongest yet innocuous restriction that can be made regardless of what comes after the embedded clause. The point at which such calculation takes place in (2) is marked with • in (3a).

(3) a. he believes that she continues to smoke •
   b. Corresponding equivalence:
      For any expression \( d' \) of a propositional type,
      \[ C \models c' \rightleftharpoons \text{he believes (c' and d')} \]

Note that the matrix verb \( \text{believe} \) has already been encountered at the point of local context calculation and the interpreter already has it on its workspace. Thus, the context set is restricted to John’s doxastic worlds, and the algorithm correctly predicts that the presupposition of (2) is ‘John believes that Mary smoked’. What is crucial in this account is that the attitude verb \( \text{precedes} \) the embedded clause. Despite the success in accounting for the English data, we are led to question what the theory would predict for a language where an attitude verb \( \text{follows} \) the
embedded clause. Korean is such a language, and the default word order is SOV. An example is provided in (4).

(4) John-un [Mary-ka (cikum-to) keysokhayse tambay-lul pi-n-tako]
    John-[TOP [Mary-[NOM (now-also) continuously cigarette-[ACC smoke-PRES-COMP]]
    mit-nun-ta.
    believe-PRES-DECL
    ‘John believes that Mary continues to smoke.’ (embedded clause > believe)

In the above example, the incremental version of Schlenker’s algorithm cannot restrict the local context of the embedded clause to John’s doxastic worlds. How the local context is computed is provided in (5). Here, the only information available to the interpreter is John. Unless the only possible sentence completion (b’ in the posited equivalence) is mit ‘believe’, the interpreter would fail to restrict the local context to John’s doxastic worlds. However, there are numerous ways to complete the sentence. One possible completion is malha(y) ‘say’ as in (6). So the algorithm predicts that the local context includes the set of worlds that are not John’s doxastic worlds and the example does not presuppose that John believes that Mary used to smoke.

(5) a. John-[TOP [Mary-[NOM continuously smoke-PRES-COMP] • believe]
   b. Corresponding equivalence:
      For any expression d’ of a propositional type, and for all strings b’ for which John d’ b’ is a well-formed sentence,

\[ C \models^{c \rightarrow x} \text{John (c’ and d’)} b’ \leftrightarrow \text{John d’ b’} \]

(6) John-un [Mary-ka (cikum-to) keysokhayse tambay-lul pi-n-tako]
    John-[TOP [Mary-[NOM (now-also) continuously cigarette-[ACC smoke-PRES-COMP]]
    malhay-ss-ta.
    say-PAST-DECL
    ‘John says that Mary continues to smoke.’

Contrary to the prediction, the example does presuppose that John believes that Mary used to smoke. We would want the local context of the embedded clause to be restricted just as much as in the English example. The issue arises because the algorithm strictly relies on linear order.

2.2. Scrambling

The naive version of Schlenker’s algorithm cannot account for the Korean scrambling example in (7). The entire embedded clause linearly precedes the matrix clause, so the interpreter does not have access to the matrix subject and the attitude verb. In fact, as shown in (8), the interpreter does not have access to any information at all. It is predicted that the local context

\[ \text{It is possible that Schlenker’s original algorithm can be improved by letting the embedded clause reconstruct before calculating its local context. However, it requires delaying the computation of the local context until the complete syntax structure is constructed and reconstruction takes place. As a result, it would weaken the theory’s main argument that local contexts are calculated in a strictly incremental fashion.} \]
of the embedded clause is the global context and the sentence presupposes that Mary used to smoke in the actual world.

(7) \[Mary-ka \ keysokhayse \ tambay-lul \ pi-n-tako] \quad John-un \ t
Mary-NOM continuously \ cigarette-ACC \ smoke-PRES-COMP \ John-TOP \ t
mit-nun-ta.
believe-PRES-DECL
(Lit.) ‘That Mary continues to smoke, John believes.’

(8) \[Mary-continuously-\ cigarette-ACC \ smoke-PRES-COMP] \quad \bullet \quad John-TOP \ t
believe-PRES-DECL
Contrary to the prediction, the sentence presupposes that Mary used to smoke in John’s beliefs.

2.3. Relative clause

Ingason (2016) raises another issue based on Japanese relative clause constructions. The Japanese examples in (9) show that the context is first updated with respect to a head noun, then with respect to its relative clause.

(9) a. Taro-ga [[\text{yamome-dearu}] \text{zyosei-ni}] atta.
Taro-NOM [[\text{widow-COP}] \text{woman-DAT}] met
‘Taro met a woman who is a widow.’

b. # Taro-ga [[\text{zyosei-dearu}] \text{yamome-ni}] atta.
Taro-NOM [[\text{woman-COP}] \text{widow-DAT}] met
‘Taro met a widow who is a woman.’

Example (9a) is felicitous because \text{zyosei} ‘woman’ updates the context first, then \text{yamome-dearu} ‘who is a widow’. Since ‘widow’ entails ‘woman’, updating ‘widow’ after ‘woman’ is felicitous. In contrast, (9b) triggers the redundancy effect because the head noun \text{yamome} ‘widow’ is more restrictive than the relative clause \text{zyosei-dearu} ‘who is a woman’. Ingason suggests that this is evidence that the order of context update mirrors syntactic hierarchy, but not linear order.

3. The hierarchy-based account

Romoli and Mandelkern (2017) reform Schlenker’s algorithm in a way that the local contexts are calculated on LF: when calculating the local context of $E$ within a full clause $S$, the interpreter considers only the expressions that c-command $S$ at $LF$, instead of considering the expressions that linearly precede it. Formally, the hierarchy-based version of local context is defined as follows:
A good-completion of $L$ at $\alpha$ is any well-formed LF which is identical to $L$ except that any clause dominated or asymmetrically c-commanded by $\alpha$ may be replaced by new material. For any sub-tree $Y$, a $Y$-good-completion of $L$ at $\alpha$ is any good completion of $L$ at $\alpha$ such that $\alpha$ is replaced by a subtree beginning with $[Y]$ and __.

The local context of expression $E$ in LF $L$ and global context $C$ is the strongest $[Y]$ s.t., where $\alpha$ is the lowest node which dominates a full clause containing $E$, for all good-completions $D$ of $L$ at $\alpha$, and for all $Y$-good-completions $D^Y$ of $L$ at $\alpha$, $[D] \cap C = [D^Y] \cap C$.

The net effect is that the expressions higher in the structure update the context first. The hierarchy-based account makes the right prediction for the Korean attitude verb example in (4), the syntax of which is provided in (12). The embedded clause is c-commanded by John and mit ‘believe’, thus the two items are taken into account and the interpreter can restrict the attention to John’s doxastic worlds.

(12) (=(4))

As for the scrambling data in (7), the hierarchy-based account can assume that the scrambled embedded clause reconstructs at LF. This would yield the LF structure in (12). Since the local context is calculated on LF, the prediction is no different from the example that does not involve scrambling.

The hierarchy-based account also correctly predicts that the redundancy effect arises in (9b), but not in (9a). The syntax of (9a) and (9a) are provided in (13a) and (13b), respectively. In calculating the local context of the relative clause in (9a), only the expressions that c-command it are taken into account, hence Taro, met, and woman. So its local context can be restricted to the set of women that Taro met. Further updating the context with widow is informative, so the redundancy effect does not arise. On the other hand, the local context of the relative clause in (9b) is the set of widows that Taro met. Thus, it would be redundant to further update the context with woman.
4. The problem of the hierarchy-based account: coordination

Romoli and Mandelkern (2017) cannot explain why contexts are invariably updated left-to-right in coordinated structures, despite the cross-linguistic variation in constituency. Let’s first take a look at the English example in (14). Applying the incremental version of Schlenker’s algorithm, the local context of the right conjunct is $C \cap \text{john-is-over-thirty}$, where $C$ refers to the global context.

(14) John is over thirty and he knows he cannot apply.

The hierarchy-based account makes the same prediction. In calculating the local context of the right conjunct, only the items that c-command it are considered: the left conjunct and the coordinator and.

(15) The hierarchy-based account: prediction borne out

The issue arises in Korean (as well as other head-final languages), where the left conjunct and the conjunction operator form a constituent. In (16), the right conjunct c-commands the left conjunct.
Given the structure in (17), the hierarchy-based account predicts that the right conjunct is updated before the left conjunct because the former c-commands the latter. However, just as in English, the entire sentence intuitively presupposes that ‘if John is over thirty, he cannot apply’. The same problem arises in disjunction because its structure is identical to that of conjunction in many languages. The coordination data call for an algorithm that makes a robust prediction despite the variation in syntactic structure.

It is noteworthy to mention an alternative view: Chierchia (2009) argues that context update takes place in the order of semantic composition. He introduced the notion of f-command which is defined in terms of function/argument relation. Informally speaking, given two arguments of a function, the argument that first composes with the functor f-commands the other argument. Chierchia’s analysis provided in (18) amounts to saying that the argument that f-commands the other updates the context first.

For example, as for the conjunction operator and, its first argument gets to update the context before the second argument. This analysis makes the right prediction for the Korean conjunction example in (16), but then something more has to be said about (14): the right conjunct is the first argument of English and. Chierchia suggests that English has a null operator, both, that forms a constituent with the left conjunct. The overt and is meaningless and the null operator carries the semantics of conjunction.
Postulating the null operator makes the right predication, however, it requires further evidence that the null operator forms a constituent with the left conjunct. To my knowledge, the overt counterpart of both cannot undergo movement together with the first conjunct, while stranding and and the right conjunct. There is no positive evidence that the two form a constituent.

Moreover, both can appear after the two conjuncts, as in (20a). If (20a) is in fact derived from (20b), it is reasonable to assume that John and Mary form a constituent, because they can be fronted while stranding both.

(20)  
   a. John and Mary both went home.  
   b. Both John and Mary went home.

The discussion is not conclusive as the syntax and semantics of coordinated structures are controversial. In fact, Ingason (2016) makes the same point and claims that the coordination data is not a serious counterexample to the hierarchy-based account. But it is worthy of mention that the left-to-right bias naturally follows from linear order-based accounts.

5. Proposal

I maintain Schlenker’s view that sentences are parsed from left to right. In addition, I assume that the interpreter constructs the syntactic structure of a given sentence during parsing (cf. Phillips 1996). Given these assumptions, I make one adjustment to Schlenker’s algorithm based on considerations from the syntax-semantics interface.

I propose that the interpreter computes the local context of expressions only at certain points in the parsing process. Specifically, the equivalence in (1) is calculated only when the semantic value of the parsed expressions can be retrieved.

(21) Adjustment: Domain-by-domin interpretation

The interpreter parses a sentence from left to right, but the local context of an expression (either propositional or predicative) can be calculated only at points where the interpreter has access to the semantic values of the parsed expressions.

The reasoning is that the equivalence posited in (1) is semantic in nature. Entailment is a semantic notion which should operate on semantic values rather than strings. And it is commonly assumed that access to semantic values of expressions is limited to certain points in the derivation. The phase theory (Chomsky, 2008) is more or less the standard view, where the semantic information of syntactic items is shipped to the interface upon construction of either vP or CP (i.e., phases). Independently, continuation semantics (Barker and Shan, 2014; Charlow, 2014)
assumes that the semantic value of an expression can be retrieved by evaluating it, and only clauses are suitable targets for evaluation.

I assume along with continuation semantics that a clause is the domain of semantic evaluation. The net effect is that the interpreter needs to postpone the calculation of local context if the parsed expressions altogether do not constitute a clause; semantic information can only be retrieved from a clause. The analyses offered in the following section do not require the technical details of continuation semantics. It suffices to assume that the semantic value of an expression can only be fetched when the parsed expressions constitute a full clause.

6. Analysis

6.1. Attitude context

The proposed analysis forces the interpreter to postpone the computation of local context until the attitude verb has been parsed. Example (4) is repeated below as (22), and the table in (23) illustrates the parsing process.

(22) John-un [Mary-ka (cikum-to) keysokhayse tambay-lul pi-n-tako]
    John-TOP [Mary-NOM (now-also) continuously cigarette-ACC smoke-PRES-COMP]
    mit-nun-ta.
    believe-PRES-DECL
    ‘John believes that Mary continues to smoke.’

(23) Derivation of (22)

<table>
<thead>
<tr>
<th>Step</th>
<th>State</th>
<th>Evaluate?</th>
<th>Target local context</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>John • [that Mary continues to smoke] believes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>John [that Mary continues to smoke] • believes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>John [that Mary continues to smoke] believes •</td>
<td>Yes</td>
<td>Embedded clause</td>
</tr>
</tbody>
</table>

The bullet points in (23) mark the positions of interest, at which the interpreter attempts to calculate the local context of the embedded clause. All expressions following the bullet points are ignored in computing the local context. The interpreter can only evaluate (i.e., retrieve the semantic value of the parsed expressions) at step 3, whereas doing so at step 1 or 2 is blocked. At step 1, the interpreter has only parsed John, which is not a full clause. Similarly, at step 2, the interpreter has encountered John that Mary continues to smoke. But again, the expressions do not form a clause. Thus, the calculation of the local context is delayed until step 3, the point at which the interpreter has access to the sentence-final believes.
6.2. Coordination

This section shows that the proposed analysis is robust to cross-linguistic variation in coordinated structures. The Korean conjunction example in (16) is repeated below as (24). The full derivation is provided in (25).

(24) [John-un selun-i nem-ess-ko] caki-ka ciwenha-ci mosha-n-ta-nun
[John-TOP thirty-NOM over-perf-and] self-NOM apply-CI cannot-PRES-DECL-REL
kes-ul al-n-ta.
thing-ACC know-PRES-DECL
‘John is over thirty and he knows he cannot apply.’

(25) Derivation of (24)

<table>
<thead>
<tr>
<th>Step</th>
<th>State</th>
<th>Evaluate?</th>
<th>Target local context</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>John is over thirty • and he knows he cannot apply</td>
<td>Yes</td>
<td>Left conjunct</td>
</tr>
<tr>
<td>2</td>
<td>John is over thirty and • he knows he cannot apply</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>John is over thirty and • he knows he cannot apply •</td>
<td>Yes</td>
<td>Right conjunct</td>
</tr>
</tbody>
</table>

Just as in Schlenker’s original formulation, the interpreter parses the sentence from left to right. At step 1, the interpreter has parsed the left conjunct. Since John is over thirty is a full clause, it can be evaluated. The general prediction is that cross-linguistic variation in coordinated structure is irrelevant to the order of context update. The left expression always updates the context before the right one.

6.3. Scrambling

The scrambling data is a challenge to any theory that relies on left-to-right bias. Since the scrambled embedded clause in (7), repeated below as (26), precedes the matrix clause, the interpreter first parses the embedded clause no matter what. On the other hand, the hierarchy-based account can assume that the embedded clause reconstructs before its local context is calculated.

(26) [Mary-ka keysokhayse tambay-lul pi-n-tako] John-un t
Mary-NOM continuously cigarette-ACC smoke-PRES-COMP John-TOP t
mit-nun-ta.
believe-PRES-DECL

(Lit.) ‘That Mary continues to smoke, John believes.’

Having tied the points of semantic access to that of evaluation, it naturally follows from continuation semantics that the local context of the scrambled embedded clause is calculated after the matrix clause has been parsed. Barker (2009) develops a mechanism which handles recon-
struction effects without actually requiring to reconstruct, namely delayed evaluation. Barker claims that English wh-phrases can be interpreted in-situ and do not require reconstruction. Specifically, delaying the evaluation of a wh-phrase and evaluating the remaining expressions beforehand replicates the reconstruction effect. For example, despite the fact that the wh-phrase who in (27) linearly precedes the rest of the sentence, it is evaluated after does John like t. The technical details of delayed evaluation is offered in appendix B.

(27) Who does John like?

I extend Barker’s analysis and claim that scrambled embedded clauses are also subject to delayed evaluation. In other words, the scrambled embedded clause is evaluated after the matrix clause has been processed. Since the local context of an expression can be calculated only when its semantic value can be retrieved, the interpreter has full access to the matrix clause when the local context of the scrambled embedded clause is calculated. The table in (28) depicts this process.

(28) Derivation of (26)

<table>
<thead>
<tr>
<th>Step</th>
<th>State</th>
<th>Evaluate?</th>
<th>Target local context</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Mary continues to smoke John believes t</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Mary continues to smoke John believes t</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Mary continues to smoke John believes t</td>
<td>Yes</td>
<td>Embedded clause</td>
</tr>
</tbody>
</table>

At step 1, the interpreter does not evaluate the scrambled embedded clause and waits for the matrix clause to be processed. At step 2, John believes t is evaluated but the evaluation of the embedded clause is delayed. Only at step 3 can the embedded clause be evaluated, and this is when its local context can be calculated as well. At this point, the interpreter is aware that the sentence is about John’s beliefs.

I would like to emphasize that delayed evaluation is not a special mechanism invented to explain how presuppositions project in scrambling constructions. It merely offers an in-situ account of reconstruction effects. Nevertheless, the order in which the derivation unfolds provides a natural explanation of the presupposition projection behavior of such constructions.

6.4. Relative clause

The redundancy effect in (9b), repeated below as (29), is also accounted for. The derivation is provided in (30).

    Taro-NOM [[woman-COP] widow-DAT] met
    ‘Taro met a widow who is a woman.
Only after step 4 can the interpreter evaluate the parsed expressions. At step 5, all of the parsed expressions except the RelP will be taken into account. In other words, the following items are considered: Taro, widow, and met. This means that the local context of the RelP is the set of individuals x such that \( \text{widow}(x) \) and \( \text{met}(x)(John) \) are true. As in the hierarchy-based account, updating the local context with that is woman is redundant.

(30) Derivation of (29)

<table>
<thead>
<tr>
<th>Step</th>
<th>State</th>
<th>Evaluate?</th>
<th>Target local context</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Taro • [NP [RelP that is woman] widow] met</td>
<td>No</td>
<td>Target local context</td>
</tr>
<tr>
<td>2</td>
<td>Taro [NP [RelP that is woman] • widow] met</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Taro [NP [RelP that is woman] widow] • met</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Taro [NP [RelP that is woman] widow] • met •</td>
<td>Yes</td>
<td>NP</td>
</tr>
<tr>
<td>5</td>
<td>Taro [NP [RelP that is woman] widow] • met •</td>
<td>Yes</td>
<td>RelP</td>
</tr>
</tbody>
</table>

7. Conclusion

This paper presents a novel parsing-based account of presupposition projection which is robust to certain crosslinguistic variations in word order. While maintaining Schlenker’s view that presupposition projection behavior is closely related to the left-to-right bias inherent in parsing, I hypothesize that local context is computed domain-by-domain, as opposed to word-by-word, and that clauses are such domains. The proposed analysis resolves the issues in Schlenker’s original algorithm and the hierarchy-based variation.

A. Formal analysis

This section fleshes out the technical details of the proposed algorithm built on continuation semantics. The reader is referred to Barker and Shan (2014) for the interpretation of tower notations.

(31) Algorithm for computing the local context of an expression E

a. The interpreter traverses a given sentence from left to right. The syntactic structure is constructed on the way.

b. Upon parsing the expression E, check whether the sequence \( A E \) can be evaluated (i.e., constitutes a clause), where A is the sequence of all of the expressions that precede E.

c. If the sequence \( A E \) can be evaluated, the local context of E which occurs in a context \( C \) is the strongest restriction \( c \) such that for any proposition \( p \) or predicate P, the following equivalence holds:

(i) For proposition \( p \):

\[
C \models \text{EVALUATE} \left( A \frac{[\ ]}{c} \text{ and } p \right) \Leftrightarrow \text{EVALUATE} \left( A \frac{[\ ]}{p} \right)
\]
(ii) For predicate $P$:

$$
C \models \text{EVALUATE}
\left( A \left\lbrack \begin{array}{c}
\text{c'
\text{and}

P
\end{array}\right\rbrack \right)
\leftrightarrow
\text{EVALUATE}
\left( A \left\lbrack \begin{array}{c}
P
\end{array}\right\rbrack \right)
$$

where $A$ is the semantic tower of $A$ and and is the generalized conjunction $\text{Op}$

d. If the sequence $A \ E$ cannot be evaluated, continue traversing until the interpreter can evaluate the sequence $A \ E \ B$, where $B$ is the sequence of all expressions which follows $E$ and was parsed by the interpreter.

e. When the parsed expressions can be evaluated, the local context of $E$ is the strongest restriction $c$ such that for any proposition $p$ or predicate $P$, the following equivalence holds: (i) For proposition $p$:

$$
C \models \text{EVALUATE}
\left( A \left\lbrack \begin{array}{c}
\text{c'
\text{and}

p
\end{array}\right\rbrack \right)
\leftrightarrow
\text{EVALUATE}
\left( A \left\lbrack \begin{array}{c}
p
\end{array}\right\rbrack \right)
$$

(ii) For predicate $P$:

$$
C \models \text{EVALUATE}
\left( A \left\lbrack \begin{array}{c}
\text{c'
\text{and}

P
\end{array}\right\rbrack \right)
\leftrightarrow
\text{EVALUATE}
\left( A \left\lbrack \begin{array}{c}
P
\end{array}\right\rbrack \right)
$$

where $A$ and $B$ are the semantic tower of $A$ and $B$, respectively, and and is the generalized conjunction $\text{Op}$

Sample derivations for the Korean attitude verb example (ex (22)) and the coordination example (ex (24)) are provided in (32) and (33), respectively.

(32) Derivation of (22)

a. The interpreter parses the sentence from left to right and reaches the end

$$
\left( \begin{array}{c}
\text{John}

\text{that Mary continues to smoke}
\text{believes}

\text{continues_to_smoke(m)}
\text{believes}
\end{array}\right) \bullet
$$

b. Replace the embedded clause with $\left\lbrack \begin{array}{c}
\text{c'
\text{and}

p
\end{array}\right\rbrack \equiv \left\lbrack \begin{array}{c}
p
\end{array}\right\rbrack$

$$
\left( \begin{array}{c}
\text{John}

\text{that Mary continues to smoke}
\text{believes}

\text{c'
\text{and}

p
\text{believes}}
\end{array}\right) \bullet
$$

c. Corresponding equivalence:

$$
C \models \text{EVALUATE}
\left( \begin{array}{c}
\text{believes(c'
\text{and}

p(j))}
\end{array}\right)
\leftrightarrow
\text{EVALUATE}
\left( \begin{array}{c}
\text{believes(p)(j)}
\end{array}\right)
$$

$$
\Leftrightarrow C \models \forall w \in \text{DOX(j)} : c'(w) = 1 \land p(w) = 1 \Leftrightarrow \forall w \in \text{DOX(j)} : p(w) = 1
$$
Derivation of (24)

a. The interpreter parses the sentence from left to right and reaches the end of the left conjunct. The expressions that follow the bullet point are ignored.

\[
\begin{array}{c}
\left( \frac{\text{John is over thirty}}{\overline{\text{over-30}(j)}} \right) \bullet \left( \frac{\text{and}}{\lambda p q, p \land q} \right) \frac{\text{he knows he cannot apply}}{\text{knows}(\text{cannot-apply}(j))(j)} \\
\end{array}
\]

b. Compute LC of the left conjunct: replace the left conjunct with \( \bar{c}' \land p \equiv \bar{c}' \land p \)

\[
\begin{array}{c}
\left( \frac{\text{John is over thirty}}{\bar{c}' \land p} \right) \bullet \left( \frac{\text{and}}{\lambda p q, p \land q} \right) \frac{\text{he knows he cannot apply}}{\text{knows}(\text{cannot-apply}(j))(j)} \\
\end{array}
\]

c. Corresponding equivalence:

\[
C \models \text{EVALUATE} \left( \frac{\bar{c}' \land p}{p} \right) \leftrightarrow \text{EVALUATE} \left( \frac{\bar{c}' \land p}{p} \right) \\
\leftrightarrow C \models \bar{c}' \land p \leftrightarrow p
\]

d. The interpreter continues to parse and reaches the end of the sentence

\[
\begin{array}{c}
\left( \frac{\text{John is over thirty}}{\overline{\text{over-30}(j)}} \right) \bullet \left( \frac{\text{and}}{\lambda p q, p \land q} \right) \frac{\text{he knows he cannot apply}}{\text{knows}(\text{cannot-apply}(j))(j)} \\
\end{array}
\]

e. Compute LC of the right conjunct: replace the right conjunct with \( \bar{c}' \land p \equiv \bar{c}' \land p \)

\[
\begin{array}{c}
\left( \frac{\text{John is over thirty}}{\overline{\text{over-30}(j)}} \right) \bullet \left( \frac{\text{and}}{\lambda p q, p \land q} \right) \frac{\text{he knows he cannot apply}}{\text{knows}(\text{cannot-apply}(j))(j)} \\
\end{array}
\]

\[
= \left( \frac{\text{John is over thirty and he knows he cannot apply}}{\overline{\text{over-30}(j)} \land (\bar{c}' \land p)} \right) \bullet
\]

f. Corresponding equivalence:

\[
C \models \text{EVALUATE} \left( \frac{\text{over-30}(j) \land (\bar{c}' \land p)}{\text{over-30}(j) \land p} \right) \leftrightarrow \text{EVALUATE} \left( \frac{\text{over-30}(j) \land (\bar{c}' \land p)}{\text{over-30}(j) \land p} \right) \\
\leftrightarrow C \models \text{over-30}(j) \land (\bar{c}' \land p) \leftrightarrow \text{over-30}(j) \land p
\]

B. Scrambling as delayed evaluation

Delayed evaluation can be schematized as in (34). Given two expressions, the right one is first evaluated. The semantic value of the right expression is fed into the left expression, yielding the composed value of the two expressions.
A sample derivation of the sentence *Who does John like?* is provided in (35).

(35) Sample derivation of *Who does John like?*

a. Initial set up

\[
\left( \frac{\text{Who}}{\lambda x. \left[ \right]_x} \right) \left( \frac{\text{John}}{\left[ \right]_j} \right) \left( \frac{\text{like}}{\lambda y. \left[ \right]_y} \right)
\]

b. Reduce the right.exp

\[
\left( \frac{\text{Who}}{\lambda x. \left[ \right]_x} \right) \left( \frac{\text{John}}{\lambda y. \left[ \right]_y} \right)
\]

c. Evaluate the right.exp

\[
\left( \frac{\text{Who}}{\lambda x. \left[ \right]_x} \right) \left( \text{John like } t \right)
\]

d. Feed the right.exp to the left.exp (function application)

\[
\left( \text{Who (does) John like } t \right) \left( \lambda x. \text{like}(x)(j) \right)
\]

Scrambling constructions receives a similar treatment. The evaluation of the scrambled embedded clause (ex (26)) is delayed.

(36) Derivation of (26)

a. The interpreter parses the fronted embedded clause, but delays the evaluation

\[
\left( \frac{\text{that Mary continues to smoke}}{\text{continues to smoke}(m)} \right) \bullet \left( \frac{\text{John}}{\left[ \right]_j} \right) \left( \frac{\text{believes}}{\lambda p. \left[ \right]_p} \right)
\]

b. The interpreter reaches the end of the sentence

\[
\left( \text{that Mary continues to smoke} \right) \left( \text{that} \right) \left( \lambda p. \text{believes} \right) \left( \text{John} \right)
\]

\[
\left( \text{continues to smoke(m)} \right)
\]

\[
\left( \text{believes} \right)
\]

\[
\cdot
\]

c. Reduce the right.exp

\[
\left( \text{that Mary continues to smoke} \right) \left( \text{John} \right)
\]

\[
\left( \lambda p. \text{believes} \right) \left( \text{believes(p)(j)} \right)
\]

d. Evaluate the right.exp

\[
\left( \text{that Mary continues to smoke} \right) \left( \text{John} \right)
\]

\[
\left( \lambda p. \text{believes(p)(j)} \right)
\]

e. Replace the embedded clause with \( c' \) and \( p \)

\[
\left( \text{that Mary continues to smoke} \right) \left( \text{John} \right)
\]

\[
\left( \lambda p. \text{believes(p)(j)} \right)
\]

\[
\cdot
\]

f. Evaluate the entire sentence: Feed the right.exp to the left.exp

\[
\left( \text{that Mary continues to smoke} \right) \left( \text{John} \right)
\]

\[
\left( \lambda p. \text{believes(p)(j)} \right)
\]

\[
\cdot
\]

g. Corresponding equivalence

\[
C \models \forall w \in \text{DOX(}\text{j}\text{)} : c'(w) = 1 \land p(w) = 1
\]

\[
\leftrightarrow \forall w \in \text{DOX(}\text{j}\text{)} : p(w) = 1
\]

The equivalence derived in (36) matches that of (32). This is indeed the desired consequence.

References


Interpreting presuppositions in the scope of quantifiers: Every vs. at least one

Abstract. This paper experimentally investigates presupposition projection from the scope of the quantifiers every and at least one, as triggered by the factive verb be aware and the iterative adverb again. The first issue we are concerned with is whether presuppositions project universally or existentially from quantified sentences. Different theoretical accounts endorse opposing views here (e.g., Heim, 1983; Geurts, 1999; Beaver, 2001; Schlenker, 2008, 2009; Fox, 2012), while recent experimental work (Chemla, 2009; Tiemann, 2014) suggests that the force of the projected presupposition varies by quantifier. The second issue we look at is how the descriptively observed readings arise—in particular, as a direct result output from the projection mechanism, or via additional, independent mechanisms such as domain restriction (e.g., Geurts and van Tiel, 2016): if the domain of the quantifier is restricted, this can yield what looks like non-universal inferences in light of the overall, unrestricted domain, even if the projection mechanism itself yields a universal presupposition. Finally, we test whether the presupposed content also forms part of the entailed content, at least for certain triggers (Sudo, 2012; Klinedinst, 2016; Zehr and Schwarz, 2016). Our results yield clearly different patterns for every and at least one, with every giving rise to universal presuppositions, which, to a very limited extent, can be weakened by domain restriction, and at least one overwhelmingly giving rise to non-universal presuppositions. Our results also indicate the availability of presupposition-less readings for both triggers in the task at hand, apparently more prevalent than domain restriction. Thereby, we present novel evidence that helps to pinpoint which of the theoretical options can be substantiated experimentally.

Keywords: Presupposition projection, quantifiers, domain restriction, entailment.

1. Introduction

One of the core properties of presuppositions is that they generally project out of a variety of embedding environments which cancel entailed content. For example, (1a-c), with the factive verb be aware as a presupposition trigger, uniformly presuppose that the alien is blue, despite being embedded under negation or in a question, both of which cancel the entailed content of the embedded material (Karttunen, 1973).

\[\begin{align*}
1 & \text{We gratefully acknowledge support from NSF-grant BCS-1349009 to Florian Schwarz. We thank the audience at the workshop Theoretical and Experimental Approaches to Presuppositions in Genoa, the audience at Sinn und Bedeutung 22, and the members at the lab meeting at UPenn for their comments.}
\]

\[\begin{align*}
& (1) \left\{ \\
& \text{a. The alien is aware that he is blue} \\
& \text{b. The alien is not aware that he is blue} \\
& \text{c. Is the alien aware that he is blue?} \\
& \right. \\
\end{align*}\]

\[\Rightarrow \text{The alien is blue}\]
However, when the presupposition trigger appears in the scope of a quantifier, there are opposing views as to whether presuppositions project universally or existentially (cf. Chemla, 2009). Some argue that quantified sentences as in (2) give rise to a universal presupposition (Heim, 1983; Schlenker, 2008, 2009), i.e., that every alien is in fact blue (3a). In contrast, others argue that semantic presuppositions of all quantified sentences are existential (Beaver, 2001, 1994); in our example that there exists at least one alien that is blue (3b).

(2) a. Every alien is aware that he is blue
b. At least one alien is aware that he is blue

(3) a. $\sim\sim\forall x \in D_{\text{alien}}\text{blue}(x)$ (\forall \text{ presupposition})
b. $\sim\sim\exists x \in D_{\text{alien}}\text{blue}(x)$ (\exists \text{ presupposition})

Recent experimental work (Chemla, 2009; Tiemann, 2014) suggests that the force of the projected presupposition varies by quantifier. Chemla (2009) uses an inference paradigm to investigate projection from the scope of quantifiers in French. The results indicate a significant difference in the availability of universal presuppositions, depending on the quantifier used: he finds evidence for universal projection from the scope of the universal quantifier each, but not from the scope of existential quantifiers (less than 3, more than 3, exactly 3). The perhaps most contested case is the negative quantifier no: Chemla argues that his data support universal projection, but more recent work by Zehr et al. (2016) provides evidence for (at least the possibility of) existential projection. Similarly, Tiemann (2014), in an eye-tracking experiment, shows that reading measures differ significantly depending on whether a universal or an existential quantifier is used. Together, these studies suggest that presuppositions do not uniformly project universally or existentially—rather, the projection behavior changes with the quantifier.

In this paper, we report data on how presuppositions triggered by be aware and again project from the scope of the quantifiers every (2a) and at least one (2b). Moreover, we test whether the descriptively observed existential projection readings are derived directly via the projection mechanism, or whether they are derived from the output of the projection mechanism through other processes. Candidates that could be at play include (implicit) Domain Restriction (Geurts and van Tiel, 2016) and the inclusion of presupposed content at the assertive level (Sudo, 2012). Our results confirm previous results in that the quantifiers every and at least one pattern differently, with every giving rise to universal readings of the presupposition, which only can be weakened by domain restriction to a limited extent, and at least one giving rise to non-universal readings of the presupposed content. This provides support for theories that tie different projection behavior to the nature of the quantifier at play, rather than treating all quantifiers as having uniform projection behavior. Furthermore, our results indicate that, at least within our task paradigm, presupposition-less readings are available for both triggers, and this option seems to be more prevalent than domain restriction.

The paper is structured as follows. Section 2 presents the background on additional mechanisms that force what seems like an existential presupposition: domain restriction and (non-)entailment. Section 3 presents the methods of our experiment, and Section 4 gives the results. Section 5 discusses the theoretical implications of the results, and Section 6 concludes.
2. Background

This section discusses two important factors that can affect whether presupposed content under quantifiers give rise to universal or existential inferences: implicit Domain Restriction (Section 2.1) and (non-)entailment of the presupposition (Section 2.2). Section 2.3 proceeds to lay out the rationale for the experiments in the present study.

2.1. (Implicit) Domain Restriction

Presuppositions triggered within the scope of a quantifier may restrict the domain of individuals considered in evaluating the quantificational claim, a mechanism known as (implicit) Domain Restriction (henceforth DR). In the presence of DR, a presupposition may be universally satisfied relative to the restricted domain, while appearing non-universal in light of the unrestricted domain. Let us illustrate with the sentence in (2a). A universal presupposition gives rise to the notion that all aliens are in fact blue. This would necessarily be incompatible with a case in which there are non-blue aliens, as in Figure 1.

However, with implicit DR, the quantifier’s domain could be restricted to those aliens that are in fact blue (i.e., the five blue aliens on the right, but crucially not the green aliens on the left in Figure 1). If such a DR is available, it should be possible to judge the sentence compatible with situations with non-blue aliens, like that in Figure 1. Therefore, if DR can come into play in the relevant sentences, it becomes non-trivial to determine whether or not the projection mechanism indeed gives rise to a universal presupposition, as what looks like a non-universal reading relative to the full domain in fact could result from interpreting the relevant presupposition universally relative to a restricted domain (Schlenker, 2008; Rothschild, 2011; Sudo, 2012). Schematically, our sentence in (2a) can effectively be understood as in (4), resulting in the inference pattern represented in (5).

\[
\forall + \text{DR: } \forall x \in D_{\text{blue-alien}} \ [\text{blue}(x)] \ \approx \ \exists x \in D \ [\text{blue}(x)]
\]

In a recent experimental study, Geurts and van Tiel (2016) investigate the effects of presuppositions on DR. Specifically, they investigate the possibility of restricting the domain of universal quantification to those individuals that satisfy the presupposition of the scope of the quantifier. In a series of truth value judgment tasks, they paired simple geometrical figures (as illustrated...
in Figure 2) with quantified sentences of the form *Each of these circles has the same color as the square to which it is connected*, in which “the square to which...” is the critical presupposition trigger. Crucially, the results show that sentences of this type are judged true 87% of the time when paired with a picture in which only four out of five circles were connected to a square (and have the same color as the square). The authors argue that this substantial amount of acceptances shows that the domain of quantification can be restricted by contextual factors. (In addition, their results also suggest, rather surprisingly, that even with numeral restrictors such as *Each of these five circles...*, as indicated in Figure 2, participants can tolerate a proper subset satisfying the presupposition in other visual arrangements.)

![Figure 2: Illustration of item used in Geurt and van Tiel’s (2016) Experiment 1](image)

In conclusion, DR forms an important factor that affects which inferences result from sentences involving projection from a quantificational context. This constitutes an important possible confound in assessing whether a given sentence gives rise to existential or universal projection, since a seemingly non-universal inference may in fact be the result of DR. Our experimental design is set up to allow for a differentiation of genuine existential projection from universal projection weakened by DR.

### 2.2. Entailed vs. non-entailed presuppositions

A second confound in distinguishing an existential from a seemingly non-universal inference is introduced if we allow for the possibility that presupposed content is also part of the conventionally entailed content (Sudo, 2012; Klinedinst, 2016). Let us illustrate with (6), which presupposes that the alien was blue at an earlier stage. However, with respect to the assertive meaning of this sentence, things are less clear. If the presuppositional content is simultaneously part of the entailed content, the conventional entailment would be as in (6a). In contrast, if the presupposition is not part of the entailed content, the conventional entailment is as in (6b).

(6) On Planet B, the alien turned blue *again*.                     **CONVENTIONAL ENTAILMENT:**

  a. **Presupposition also entailed**: the alien turned blue & *was blue at an earlier stage*
  b. **Presupposition entirely separate**: the alien turned blue
Note that, while (6b) and (6a) are contextually equivalent given the presupposition, the contrast between entailment versus non-entailment of the presupposition could interact with projection. In particular, universal quantifiers yielding a universal reading for a presupposition that is also entailed would simply be the result of assessing the quantificational claim relative to the entailed content (which, by hypothesis, includes the presupposition) and thus does not necessarily indicate universal projection. A key question is how we settle the issue of whether a given trigger simultaneously introduces its presupposition as an entailment as well. Indeed, Sudo (2012) argues that presupposition triggers can differ precisely in this regard, and Zehr and Schwarz (2016) provide some initial evidence from non-monotonic quantifiers (where the predictions come apart most clearly, as observed by Sudo). Our working hypothesis, building on prior work, is that aware is a good candidate for entailing its presupposition (Djärv et al., 2017), while again does not seem to entail its presupposition (Zehr and Schwarz, 2016).

A further complication arises when considering the possibility of presupposed content forming part of the entailments as well is that most theories of presupposition allow for some version of local accommodation (Heim, 1983), which effectively turns presupposed content into entailed content, while cancelling its contribution qua presupposition. This is distinct from the notion of entailed presuppositions we just introduced, but not easy to tease apart empirically. Different types of triggers are commonly thought to differ in how easily available local accommodation is, with triggers like again showing more resistance to such readings. See Klinedinst (2016) for a discussion of local accommodation vs. entailed presuppositions.

2.3. The design of the present study

Putting the various factors together (universal vs. existential projection, DR, and (non-)entailment), there is a total of five different logically possible readings for the presupposed content in a given quantifier-trigger combination. The first possible reading is a universal reading that is derived directly from universal presupposition projection (∀ in Table 1) and that yields an unrestricted universal inference throughout. The second reading is an existential reading that is derived directly from existential presupposition projection and in which the presupposition features in the entailed content (∃ + EntPS), and which yields universal inferences for universal quantifiers only. The third reading is an apparent existential reading (relative to the full domain) that is derived from universal projection by DR. The fourth reading is an existential reading that is derived from existential presupposition projection and in which the presupposition does not feature in the entailed content (∃ + no EntPS). And finally, the fifth reading is a presupposition-less reading (PS-LESS in Table 1), as presuppositions are well-known to be subject to suspension or cancellation. These readings are illustrated in Table 1 with the factive trigger aware (left) and the iterative trigger again (right).  

We designed an experiment to further investigate the projection behavior of presuppositions in the scope of quantifiers, and, specifically, to tease apart the different readings in Table 1 within a single design. The question we aim to answer is whether, in case of an existential

---

2The schematic pattern used in the table is shorthand for (based on the example with aware in row 1) ‘all aliens in fact ARE blue, and Q aliens THINK they are blue’, where Q is the relevant quantifier.
Table 1: The five different possible readings for the interpretation of presuppositions in the scope of quantifiers, in which Q stands for every or at least one.

<table>
<thead>
<tr>
<th>Presupposition</th>
<th>Assertive Dimension</th>
<th>Presuppositional Dimension</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ∀</td>
<td>all are, Q thinks blue</td>
<td>Q is blue</td>
</tr>
<tr>
<td>2. ∃+Entailment</td>
<td>one⁺ is, Q is &amp; thinks blue</td>
<td>one⁺ was, Q was &amp; is blue</td>
</tr>
<tr>
<td>3. DR</td>
<td>Q blue thinks blue</td>
<td>Q previously blue is blue</td>
</tr>
<tr>
<td>4. ∃−Entailment</td>
<td>one⁺ is, Q thinks blue</td>
<td>one⁺ was, Q is blue</td>
</tr>
<tr>
<td>5. PS-LESS (−Ent.)</td>
<td>Q thinks blue</td>
<td>Q is blue</td>
</tr>
</tbody>
</table>

presupposition, the presupposition is derived directly via presupposition projection or via the predicted presupposition in combination with some other mechanism (DR, (non-)entailment). Moreover, we use two different triggers (aware, again) and two quantifiers (every, at least one) to test whether projection behavior differs across triggers and/or quantifiers.

3. Methods

3.1. Materials & Design

We use a picture-matching task with a (partially) covered box (Huang et al. 2013). In a covered box task, subjects are asked to select a match for a given sentence among various pictures, one of which is hidden. The covered box allows for a choice that better fits with subjects’ expectations without making it salient, thereby avoiding a situation in which they must give either a direct yes or no response when neither seems quite appropriate, as is often the case due to presuppositional requirements.

The experiment consists of two sub-experiments: one with the factive trigger aware, and one with the trigger again. Each sub-experiment includes the quantifiers every and at least one. For the sub-experiment with aware, sentences of the form Q alien is aware that he is color were used (in which Q stands for either every or at least one, and the specific color differed per trial). To establish a plausible context, participants were told that the aliens cannot directly perceive their own skin color, and that they can only find out what color they have through the use of a machine, which sometimes may malfunction, leading to wrong ideas about their own color. Written sentences were presented along with two pictures of seven aliens (see Figure 3). The aliens’ actual color represents the presuppositional dimension and the thought bubble-renderings of the aliens’ beliefs represent the assertive dimension. In the ‘covered box’ picture, the aliens and thought bubbles were hidden by black squares.

Figure 3: Example item for a sentence like Every/at least one alien is aware that he is blue.

In the sub-experiment with the trigger again, sentences like Q alien turned color again were
used. These sentences were paired with pictures showing aliens traveling from a home planet on which they had a certain color (the presuppositional dimension) to a planet that we called Planet A on which they all lost their color, indicated by showing them as gray, and finally to a third planet (Planet B) on which they turned a color (other than gray) again. Planet B represents the assertive dimension. In the covered box picture, the aliens on the home planet and on Planet B are covered with black boxes. This is shown in Figure 4.

![Diagram of alien journey from home planet, to Planet A, to Planet B](image)

Figure 4: Example item for a sentence like *Every/at least one alien turned blue again.*

We included 6 conditions for each quantifier, of which 3 were critical conditions (∃PS1, ∃PS2, and FALSEPS) and 3 were control conditions (FALSEASSERTION, ALLTRUE, and ALLFALSE).

In addition to the types of materials introduced in detail, a block of sentences with the negative quantifier no was included, both to see whether it exhibited a pattern closer to *at least one* or *every* and also whether the effects for *every* and *at least one* would be affected by seeing the block of sentences with no before or after the block that included *every* or *at least one*. However, the results for no were complex in a way that goes beyond what we have space for in the present paper, and as there was no significant impact of no-blocks preceding either one of the other quantifiers, we will collapse the data for those quantifiers from subjects seeing different block orders, yielding one group of subjects that saw trials with *at least one* (either before or after a no-block) and another that saw trials with *every* (again, in either order with the no-block). There were 5 items per condition per quantifier, so that every subject saw 30 items with *at least one* or *every* and 30 items with no, counterbalanced so that each item was only seen in one condition. The next section lays out the conditions that were used in the experiment in detail.

3.2. Conditions & Predictions

The conditions consist of picture-variations using different color distributions, which in turn yield varying compatibility with the candidate interpretations as defined in Table 1 above. The color distributions are equivalent in the two sub-experiments with aware and again: rotating the pictures for again 90° counter-clockwise shows the similarity with the pictures for aware. Each condition displays different pictures for the quantifiers *at least one* and *every*, to account for the interplay of quantifier and the various factors affecting the resulting presupposition reading.
The predictions in terms of compatibility with the candidate interpretations that were defined in Table 1 are given in Table 2 for *at least one* and in Table 3 for *every*.

<table>
<thead>
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<th>Aware</th>
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<tr>
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<th>FALSEPS</th>
<th>FALSEASS.</th>
<th>ALLTRUE</th>
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<tr>
<td>∃+ENT.</td>
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<td>✗</td>
<td>✗</td>
<td>✗</td>
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<tr>
<td>∃−ENT.</td>
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<td>√</td>
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</tr>
<tr>
<td>PS-LESS</td>
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<td>✓</td>
<td>✓</td>
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Table 2: Predictions for the quantifier *at least one* in a sentence like *At least one* alien {is *aware* that he is blue / turned blue *again*} in the 6 conditions for the triggers *aware* (top row of images) and *again* (bottom row of images).

<table>
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<th>∃PS2</th>
<th>FALSEPS</th>
<th>FALSEASS.</th>
<th>ALLTRUE</th>
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</tr>
<tr>
<td>∃+ENT.</td>
<td>✓</td>
<td>✗</td>
<td>✗</td>
<td>✗</td>
<td>√</td>
<td>✗</td>
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<td>DR</td>
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<td>√</td>
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</tr>
<tr>
<td>∃−ENT.</td>
<td>✓</td>
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<td>√</td>
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</tr>
<tr>
<td>PS-LESS</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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Table 3: Predictions for the quantifier *every*, in sentence like *Every* alien {is *aware* that he is blue / turned blue *again*} in the 6 conditions for the triggers *aware* (top row of images) and *again* (bottom row of images).

The critical conditions for *at least one* are set up as follows: (i) ∃PS1 is incompatible with a universal reading, since there are aliens that are not blue, but it is compatible with all other readings. (ii) ∃PS2 is only compatible with two readings: an existential reading where the presupposition is entirely separate from the entailed content, as there is no alien that both is blue and thinks that they are blue, and a presupposition-less reading, which merely requires there to be at least one alien that thinks that they are blue. (iii) FALSEPS is only compatible with a presupposition-less reading, since there are no aliens that actually are blue. The comparison between the latter two thus will be indicative of the existence of an existential reading without an entailed presupposition (and there is no independent requirement for the presupposition and
entailed content to hold of the same individual(s); cf. the ‘Binding problem’ for presuppositions), as higher levels of acceptance in $\exists PS2$ could only be due to the availability of such a reading. The comparison between $\exists PS1$ and $\exists PS2$ will indicate to what extent either DR or an entailed presupposition is at play.

The pattern of compatibility with the conditions for every is slightly different. (i) In addition to being incompatible with the universal reading, as for at least one, $\exists PS1$ is incompatible with existential projection and an entailed presupposition, since every requires all entailed content to hold universally. (ii) $\exists PS2$ can only be accepted under a DR reading, since not all aliens are blue, and not all aliens think that they are blue. Only if the sentence is evaluated relative to a domain restricted to blue aliens can it be accepted. (iii) As before, $\exists PS2$ can only be accepted under a DR reading, since not all aliens are blue, and not all aliens think that they are blue. Only if the sentence is evaluated relative to a domain restricted to blue aliens can it be accepted. (iii) As before, FALSEPS is laid out so that the overt picture can only be accepted under a presupposition-less reading, as there are no blue aliens, but all aliens think they are blue.

Control items implement the same conceptual manipulation with adjustments as necessary for whichever quantifier is used: (iv) For FALSEASSERTION, the assertion is false since none of the aliens think that they are blue, but the presupposition is universally met, since all aliens actually are blue. (v) ALLTRUE completely fits with both universal presupposition and the respective asserted requirements (regardless of entailment). Finally, (vi) for ALLFALSE, neither the presuppositional requirements (on any variant) nor the assertive ones are met. These control items serve to assess participants’ understanding of the task and provide points of reference at both the ceiling and floor levels.

3.3. Participants & Procedure

160 undergraduate students at the University of Pennsylvania took part in the experiment for course credit. Half of them took part in the sub-experiment with aware, and the other half with again. Both sub-experiments varied the quantifiers every and at least one as a between-subjects factor. The experiment was implemented in Ibex. The presentation order and whether the covered box appeared on the left or on the right was randomized in Ibex.

Participants were seated in front of a computer and were told that they have to determine which of two pictures corresponds to a sentence description. The experiment started with instructions that showed participants the aliens they would be seeing. For aware, participants were told that the aliens are not able to directly perceive their skin color. Rather, a sometimes dysfunctional machine informs the aliens about their color. For again, participants were told that the aliens change color going from planet to planet. They travel from their home planet to planet A (where they turn gray), and on to planet B. Participants were instructed to press the F key on their keyboard to accept the left picture, and the J key to accept the picture on the right. We included a couple of practice trials with feedback, after which the actual experiment started.  

Archive versions of the experiment can be found at [http://spellout.net/ibexexps/SchwarzLabArchive/AvaQPsAgain/](http://spellout.net/ibexexps/SchwarzLabArchive/AvaQPsAgain/) (Again) and [http://spellout.net/ibexexps/SchwarzLabArchive/AvaQPsAware/](http://spellout.net/ibexexps/SchwarzLabArchive/AvaQPsAware/) (Aware).
4. Data analysis & results

We used logistic regression mixed effect models to predict the choice of the visible picture, using the lme4 package (Bates et al., 2015: version 1.1–13) in the R environment (version 3.3.3). We computed models on each pair of conditions for which different readings make different predictions, for the quantifiers at least one and every (see Tables 2 and 3). In addition to Condition, all the models whose outputs we report here included another two-level predictor: Trigger (aware = -1 vs. again = 1). In our reports below, we always mention the condition coded as -1 first, and the condition coded a 1 second. The models tested both for simple effects and for interactions between the two factors. Following the procedures for model simplification in Bates et al. (2015), we fitted models with a maximal random-effect structure (random slopes for Condition per Subject and random intercepts for items) and proceeded to an iterative reduction. As a result, when appropriate, we report models that forced a zero correlation on Condition per subject (using the ‘∥’ syntax of lmer()). Whenever both types of models would converge, their outputs were qualitatively equivalent. Goodness of fit was reported to significantly decrease in all models dropping the random slope for Condition per Subject.

Besides the unfiltered data set, we ran models with data sets that excluded subjects with an accuracy of under 65% (excluding 4 participants), under 70% (excluding 6 participants), and under 75% (excluding 11 participants) on the ALLTRUE and ALLFALSE items. Since this filtering on accuracy hardly ever made a difference in terms of eliciting significant contrasts, we report the outputs of the models run on untrimmed data sets, except when the models failed to converge in which case we report the next most conservative converging model.

The results are presented in Figure 5 for the quantifier at least one and in Figure 6 for every. We start by discussing the results for at least one, after which we discuss the results for every. In Section 4.3, we discuss the data in terms of different sub-groups, which indicates that individual participants (consistently) adopted different strategies.

4.1. Results at least one

The results for at least one are presented in Figure 5. As expected, target acceptance rates for the ALLFALSE, FALSEPS, and ALLTRUE conditions are at floor and ceiling, respectively, for both triggers. Note further that the results on the different conditions are very similar for the different triggers. In our analysis, we first compared the choice of visible picture in the conditions ∃PS1 and ALLTRUE. A contrast here would be indicative of unrestricted universal projection (∀) (see the ∀ row in Table 2). Neither the full model nor the zero-correlation model converged. The next most conservative converging and parsimonious model is a zero-correlation model with the data set that is filtered for 65% accuracy. The model does not reveal a significant difference (β = 0.0811, SE = 0.2620, p = 0.7571), indicating that unrestricted universal presupposition readings were not at play for our participants in responding to the at least one items. Second, we compared ∃PS1 and ∃PS2. Both of these should be accepted across the board if (‘unbound’) ∃-ENTAILED or PS-LESS readings are widely available. A contrast between the two would point to ∃+ENTAILED or DR
To summarize, the only significant differences our models detected were between the ∃PS1 and ∃PS2 conditions and between the ∃PS2 and FALSEPS conditions. The contrast between ∃PS1 and ∃PS2 suggests that for both triggers, either a reading where the presupposition is also part of the entailed content is available, or else one based on DR (though this seems less likely, given the results for every below). As was noted above, presuppositions can wind up contributing to entailed content directly in at least two ways, as local accommodation can render a comparable
result (while removing the presuppositional component altogether), and our results here do not differentiate between these possibilities. The contrast between \( \exists \text{PS2} \) and \( \text{FALSEPS} \) suggests that, to a limited extent, subjects accepted \( \exists \text{PS2} \) under a reading where the presupposition is not part of nor bound to the entailed content. Numerically, the difference seems to be bigger for \textit{again} than for \textit{aware}. We will discuss the availability of \( \exists \text{-ENTAILED} \) and \( \exists \text{+ENTAILED} \) readings in more detail in Section 4.3, after discussing the results for \textit{every} in the next section.

4.2. Results \textit{every}

The results for \textit{every} are presented in Figure 6. Again, the target acceptance rates for the \textit{ALLFALSE}, \textit{FALSEPS}, and \textit{ALLTRUE} conditions are at floor and ceiling, respectively, for both Triggers. Similar to the data for \textit{at least one}, the results on the different conditions pattern similarly for the two triggers. However, for \( \exists \text{PS1} \), the results are quite different from those for \textit{at least one}, pointing to clear differences in descriptive projection patterns between quantifiers.

![Figure 6: Results for the items with the quantifier every, for sentences like: Every alien \{is aware that he is blue / turned blue again\} with the triggers aware and again.](image)

The first model we ran compared the \( \exists \text{PS1} \) and \textit{ALLTRUE} conditions, for which generally available unrestricted \( \forall \) projection and \( \exists \text{+ENTAILED} \) both predict a difference (with either predicting rejection of \( \exists \text{PS1} \)). Indeed, our model shows a significant contrast between the two conditions (\( \beta = 1.0712, SE = 0.2402, p < 0.001 \)). Second, we compared \( \exists \text{PS1} \) and \textit{ALLFALSE}, for which DR, \( \exists \text{-ENTAILED} \), and PS-LESS readings predict a difference (acceptance for \( \exists \text{PS1} \)). The model reveals a significant contrast between the conditions (\( \beta = -1.0887, SE = 0.2164, p < 0.001 \)). Third, we compared \( \exists \text{PS1} \) and \( \exists \text{PS2} \). If there is no significant contrast between these conditions, this would show that Domain Restriction accounts for all of the acceptances in \( \exists \text{PS1} \). However, the model shows a significant contrast (\( \beta = -4.3254, SE = 0.7970, p < 0.001 \)), which suggests that DR cannot account for all of the difference between \( \exists \text{PS1} \) and \( \exists \text{PS2} \). Rather, some of the acceptances of \( \exists \text{PS1} \) must be based...
on a $\exists$-ENTAILED or a PS-LESS reading. Fourth, we compared $\exists$PS1 and FALSEPS to assess the extent to which acceptance in the former is driven by a PS-LESS reading. We find a significant contrast ($\beta = -0.7489, SE = 0.1899, p < .001$), suggesting that not all such responses are based on this reading. Fifth, we compared the $\exists$PS2 and ALLFALSE conditions, for which only a reading that follows from DR predicts a difference. No such contrast was revealed by our model ($\beta = -0.1761, SE = 0.2788, p = 0.5276$), suggesting that DR does not play a role. However, in the next section we will discuss the individual results, which show that, even though DR might be limited, there are some subjects with high acceptance rates for $\exists$PS2. Finally, we compared the acceptances of the overt picture for FALSEPS and ALLFALSE, for which only a PS-LESS reading predicts a difference. Again, the model did not reveal a significant contrast ($\beta = -0.2736, SE = 0.3923, p = 0.4855$). However, again, even though the model does not show a significant contrast, there appears to be a proportion of the subjects with high acceptance rates for FALSEPS. We will discuss this in the next section.

To summarize, the results for every show a significant difference between $\exists$PS1 and TRUE and between $\exists$PS1 and ALLFALSE. The first finding provides clear evidence that presuppositions triggered from the scope of every have a universal projection (and/or a $\exists$+ENTAILED projection; see discussion below). The second contrast could be driven by a DR reading, a $\exists$–ENTAILED reading, or a PS-LESS reading. Clearly, these results require closer inspection. Several additional aspects of the data indicate that a closer look at the distribution of the answers of the different participants is in order. First, the results on most critical conditions (in contrast to the control conditions) for both at least one and every do not show 100% acceptances or rejections. This could be caused by a bimodal distribution in the acceptance rates (inter-subject differences). Moreover, the comparison between $\exists$PS1 and $\exists$PS2 and between FALSEPS and ALLFALSE does not provide a significant difference, although we see quite large numerical differences as well as some individuals who have high acceptances on $\exists$PS2 and on FALSEPS. Finally, note that we found a much greater fit for models allowing for random slopes for Condition per Subject. This shows that the slopes capture significant variation in effect size per subject; the models with random slopes therefore reduce the residual variance. However, the models that drop the random slopes (which we fit to arrive at the most parsimonious model in terms of the random-effects structure) indicate significant differences where conditions descriptively appear to contrast. This is for instance the case with the two final comparisons that we discussed in this section: between $\exists$PS2 and ALLFALSE and between FALSEPS and ALLFALSE. We need to further inspect the data to see whether the variance that is captured by the slopes actually comes from a “real” difference that is masked by the random slope. In the next section, we therefore explore the individual participants’ profiles, and we show that there are different speaker populations.

4.3. Participants’ profiles

Based on the results, this section further inspects the different participants’ profiles, first for at least one, and then for every.
4.3.1. At least one

While statistical comparisons of $\exists$PS2 and ALLFALSE and of FALSEPS and ALLFALSE did not reveal significant contrasts, we found fairly large numerical differences. We inspected individual participants’ profiles on the FALSEPS and $\exists$PS2 conditions to better understand the source of the numerical contrasts, in particular with regards to participants’ consistency in responses as well as the individual response patterns across relevant conditions. Recall that FALSEPS can only be accepted under a PS-LESS reading, and that $\exists$PS2 can be accepted under a PS-LESS reading as well as a $\exists$-ENTAILED reading. Figure 7 plots the mean acceptance on FALSEPS on the y-axis and the mean acceptance on $\exists$PS1 on the x-axis. While most participants reject the overt picture in both conditions, there is a small but not insubstantial number of subjects who consistently accept the overt picture, especially for aware. Furthermore, the roughly linear increase in the distribution suggests a correlation between accepting FALSEPS and $\exists$PS2, which is expected if acceptance is based on their ability to access a PS-LESS reading. There are a few subjects that diverge from this distribution. This is clearer for again than for aware: these subjects consistently accept the overt picture in $\exists$PS2 but not in FALSEPS, suggesting that they access a $\exists$-ENTAILED reading.

![Figure 7: By-subject plot on the conditions $\exists$PS2 and FALSEPS with the quantifier at least one and the triggers aware (left) and again (right).](image)

4.3.2. Every

For every, our models similarly failed to find a significant contrast between ALLFALSE and $\exists$PS2 on the one hand and FALSEPS on the other, despite non-negligible-seeming numerical contrasts. The former contrast would indicate the availability of DR, and the latter a PS-LESS reading. We inspected individual response distributions to assess the source of the sizable numerical effects as well as potential individual response patterns.

Starting with FALSEPS, the y-axis distribution in Figure 8 shows that a large proportion of
subjects—close to half—accepts the target in this condition quite consistently, often at ceiling levels. This suggests that PS-LESS readings are systematically available for some subjects. While the significant contrast with ∃PS1 reported above suggests that not all acceptances in that condition are due to PS-LESS readings, it is still possible that a large portion of them are. Indeed, comparing the x-axis to the ∃PS1-response distribution on the y-axis in Figure 8 suggests a strong correlation between these two conditions for aware, as participants who accept ∃PS1 also accept FALSEPS, while participants who reject ∃PS1 also reject FALSEPS, with only a couple of exceptions. This indicates that a PS-LESS reading of aware is consistently available for at least some of the participants, and furthermore that to a large extent, acceptance in ∃PS1 is also driven by this reading (rather than DR or an ∃-ENTAILED reading).

Figure 8: By-subject plot on the conditions ∃PS1 and FALSEPS with the quantifier every and the triggers aware (left) and again (right).

Interestingly, it is less clear that there exists such a correlation for every with the trigger again. As can be seen on the right side in Figure 8, with again, there are some participants who systematically reject the overt picture for FALSEPS while still accepting ∃PS1 in at least a portion of the cases. Note that ∃PS1 could be accepted under a reading that comes from DR, from a ∃-ENTAILED reading, or from a PS-LESS reading. It is safe to conclude that those people who reject FALSEPS do not accept ∃PS1 under a PS-LESS reading. Note further that ∃PS2 can only be accepted under a DR reading, and that we see a much higher acceptance of ∃PS1 compared to ∃PS2 in Figure 6. Therefore, it is likely that an explanation for the difference between the presupposition triggers should be sought in the idea that triggers can differ with regards to whether or not their presupposition also features in the entailed content (Sudo, 2012). In line with results from previous studies (Djärv et al., 2017; Zehr and Schwarz, 2016), our results suggest that aware entails its presupposition (unless one has a PS-LESS interpretation of aware), while again does not entail its presupposition.

Finally, Figure 9 plots the distribution of results across participants for ∃PS2, to further investigate the role of DR, which our overall statistical results suggest is quite limited. The histogram shows that, while the overwhelming majority of the subjects never accept the overt picture for ∃PS2, there are some subjects who (sometimes) accept the picture and, thus, necessarily apply
DR. In total, there are 4 subjects who have high acceptance rates (>80%) for ∃PS2 with aware and 7 subjects with again. This indicates that, although very limited, DR is an available reading for some of the subjects in our study.

![Figure 9: Histogram of the mean acceptance rate on ∃PS2 with the quantifier every and the triggers aware (left) and again (right).](image)

5. Discussion

The experiments in this paper were set up to address a) whether presupposed content under quantifiers gives rise to universal or existential presupposition-based inferences and b) whether the observed reading(s) arise(s) as a direct result of the projection mechanism or via additional mechanisms such as Domain Restriction and (non-)entailment of the presuppositional content. We used two different triggers (aware, again) and two quantifiers (every, at least one) to test whether projection behavior differs across triggers and/or quantifiers.

Our data provide clear confirmation that presupposition-based inference patterns vary by quantifier, in line with previous results by Chemla (2009) and Tiemann (2014): targets with non-universally met presuppositions are readily accepted for at least one but much less often so for every. Moreover, the results show that the overall results pattern is quite comparable across the two triggers, although we do observe subtle differences in terms of entailment for the different triggers.

As for determining how the descriptively universal and existential readings for the two quantifiers should be accounted for in theoretical terms, a detailed consideration of the various factors at play is required. The rejections of ∃PS1 for every, reflecting a descriptively universal inference, can be accounted for either in terms of universal projection (∀) or via existential projection plus an entailed presupposition. However, if we assume that again does not entail its presupposition, as suggested by prior work as well as by some aspects of our results, then this finding is indeed supportive of ∀-projection from the scope of every.

Importantly, the extent to which responses indicating non-universal readings for every can be attributed to DR in our data seems to be extremely limited, as we find no general statistically significant effects directly attributable to DR. This is in contrast to previous findings by Geurts...
and van Tiel (2016). At the same time, however, there are some individual participants who show consistent acceptance of targets that are only compatible with universal projection relative to a restricted domain, suggesting that this interpretative option is in principle available but only accessible to few speakers in our experimental context.

In addition to the variation in presupposition-based inference patterns between quantifiers, we also find variation between readings that incorporate presupposed content as part of the entailed content and readings that do not. This is the case for both triggers, although there are some indications of differences between triggers as well. For the quantifier at least one, we find that a fair number of participants accept overt pictures that are only compatible with a ∃-ENTAILED reading or a PS-LESS reading. The former would be expected, to some extent, for again, based on results from prior work arguing it to be a non-entailing trigger. For aware, the availability of either reading is more surprising. However, it is quite plausible that in this case, the result is attributable to the specific nature of the task at hand rather than a lexical property of aware. In particular, given the context provided in the instructions, where the aliens rely on sometimes faulty machines to form beliefs about their own color, there may be a notion of aware that takes into account a perspectival shift of sorts: as far as the alien in question is concerned, they may perfectly well have reasonably justified belief about their color based on the machine-feedback, even if that feedback could be faulty, as that is the only source of information at their disposal. It is in light of this justification from the perspective of the alien that one could describe them as ‘aware’ of their color, even if they wind up getting the color wrong.4 What appear to be ‘presupposition-less’ readings in descriptive terms might then be regular presuppositional readings with some shift in perspective.

Turning to again, we find some evidence for both types of readings, but these may need to be accounted for in different terms. First, if we assume (following previous work) that again does not entail its presupposition, the observation of ∃-ENTAILED is straightforwardly accounted for.5 A non-entailed representation of again also accounts for the responses of participants who, at the same time, rejected overt pictures only compatible with PS-LESS readings, and leaves open the possibility of local accommodation to account for the responses of the participants who showed no evidence of accessing ∃-ENTAILED or PS-LESS readings of again. However, it is in principle possible that in certain circumstances, the presupposition of again can simply be ignored, which accounts for observations of PS-LESS readings.

6. Conclusions

Presuppositions give rise to different inference patterns from different quantifiers, as documented here for universal and existential ones. Theoretical accounts of these differences are complicated by a variety of factors, such as Domain Restriction and (non-)entailment of presuppositions. In light of previously proposed differences between types of triggers, our results suggest that the projection mechanism itself yields universal and existential readings from the respective quantifiers and that Domain Restriction at best plays a very limited role. At the same

4Thanks to Jeff Lidz for first spelling out this possibility for us in fully explicit terms.
5Though note that Sudo (2012) proposes cross-dimensional anaphora to account for exactly one binding its quantified variable in the presuppositional as well as in the assertive dimension, thus predicting rejection in ∃-ENTAILED, where no alien satisfies both dimensions at the same time.
time, there is substantial variation in the types of readings that are possible for these presupposition triggers, and, ultimately, further work is needed to pin down which theoretical properties the various interpretative effects should be attributed to. This will also require the investigation of a wider range of triggers and quantifiers.

References


A new kind of epistemic indefinite
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Abstract. Tiwa (Tibeto-Burman; India) has two series of epistemic indefinites: one whose epistemic effects arise via an anti-singleton constraint similar to Spanish algún (Alonso-Ovalle and Menéndez-Benito, 2010), and another, wide-scope indefinite whose epistemic effects must be derived differently. I propose that for these latter indefinites, ignorance arises not through domain constraints, but as a result of their choice functional nature through competition with other indefinites. Tiwa’s wide scope indefinites then constitute a new kind of epistemic indefinite, showing that ignorance implicatures for indefinites can arise through different sorts of competition.

Keywords: epistemic indefinites, wide scope indefinites, choice functions, implicature, Tiwa.

1. Introduction

Epistemic indefinites are indefinite pronouns and determiners that convey that the speaker is ignorant with respect to the witness to that indefinite (Alonso-Ovalle and Menéndez-Benito, 2015). An example of this is Spanish algún (Alonso-Ovalle and Menéndez-Benito, 2010). When speakers use algún in non-downward-entailing environments, they convey that they are ignorant with respect to the identity (or number) of the witness. Alonso-Ovalle and Menéndez-Benito (2010) attribute these epistemic effects to a conversational implicature that arises due to the domain requirements of algún. Specifically, algún places an anti-singleton requirement on its domain: it cannot range over a singleton set. Adopting the neo-Gricean analysis that Kratzer and Shimoyama (2002) propose for similar effects with German irgendein, Alonso-Ovalle and Menéndez-Benito derive the epistemic effects of algún as a quantity implicature that arises through avoidance of a false exhaustivity inference. Specifically, in using an indefinite that ranges over a non-singleton domain, the speaker makes a weaker statement than if she used a singleton competitor. From this, the hearer reasons that the speaker did so to avoid implying that she believes some of the alternatives are false (through an exhaustivity inference). The hearer concludes that the speaker does not know that some of these alternatives are false, which

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1 Thanks to Mary and Bibiana Maslai, and the rest of the Tiwa community of Umswai for sharing their language with me. Thanks also to Amy Rose Deal, Line Mikkelsen, Seth Yalcin, Peter Jenks, Sarah Murray, and audiences at TripleA 4, Sinn und Bedeutung 22, NELS 48, and UCSC’s S-Circle for comments, suggestions, and feedback. Any errors are mine alone. This research was made possible by two Oswalt Endangered Languages grants.
2 Other epistemic indefinites that have been discussed in the literature include German irgendein (Kratzer and Shimoyama, 2002), Italian un qualsiasi (Aloni and van Rooij, 2004; Chierchia, 2006) and un qualche (Zamparelli, 2007), French quelque and un quelconque (Jayez and Tovena, 2006, 2007), the Russian -to series (Kagan, 2011), Romanian vreun (Farkas, 2002; Fălăuş, 2014), the Japanese -ka series (Alonso-Ovalle and Shimoyama, 2014), and the Czech -si series (Šimík, 2015). Note that not all epistemic effects associated with indefinites have been analyzed as conversational implicatures.
3 German irgendein conveys speaker ignorance or indifference with respect to the witness. The domain requirements irgendein places are different from those of algún: instead of simply requiring a non-singleton domain, irgendein is a domain widener. This difference manifests in its epistemic component: irgendein requires that the speaker be ignorant with respect to the entire domain, while algún allows for ignorance with respect to a subset of the domain.
results in the ignorance implicature.

Tiwa, a Tibeto-Burman language of India, has two distinct series of epistemic indefinites, whose epistemic effects, I will argue, arise pragmatically. These are the -khi series and the -pha series, illustrated in (1) and (2) respectively. In both cases, it is infelicitous for the speaker to use a -khi or -pha indefinite and then identify the witness: in using these indefinites, the speaker has conveyed ignorance.

(1) Shar-khí phi-dom. # Pe-do Mukton.
who-KHI come-PST 3SG-TOP Mukton
‘Someone came. # Namely, Mukton.’ [2017.1.81]

(2) Shar-pha phi-dom. # Pe-do Mukton.
who-PHA come-PST 3SG-TOP Mukton
‘Someone came. # Namely, Mukton.’ [2017.1.81]

These indefinites contrast with the plain, non-epistemic indefinite, the numeral “one”, which can be felicitously followed with an explicit identification of the witness. This is shown in (3).

(3) Sája lbing phi-dom. Pe-do Mukton.
one.CL person come-PST 3SG-TOP Mukton

In this paper, I show that the epistemic effects associated with both -khi and -pha indefinites in Tiwa arise as conversational implicatures, but that they must arise in different ways. In particular, the epistemic effects associated with -pha arise as a consequence of its anti-singleton domain requirements, similar to Spanish algún. In contrast, the epistemic effects of -khi, a wide scope choice functional indefinite, arise not through domain requirements, but as a result of the indefinite’s choice functional nature. Tiwa’s -khi indefinites then constitute a new kind of epistemic indefinite, one whose epistemic effects are pragmatic, but do not arise as a consequence of domain requirements.

The paper is structured as follows. In §2 I show that the ignorance effects associated with -khi and -pha indefinites behave like a conversational implicature. In §3 I propose an analysis for -pha indefinites following that proposed by Alonso-Ovalle and Menéndez-Benito (2010) for

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4Tiwa is spoken by approximately 27,100 people primarily in west Karbi Anglong district, Assam, India (2001 estimates; Simons and Fennig 2017). The data used here were collected by the author in Umswai, Karbi Anglong over the course of two summers (2016 and 2017).


6Not every epistemic indefinite discussed in the literature has been analyzed as involving conversational implicature. Aloni and Port (2015), for example, argue that the epistemic component of such indefinites is better analyzed as a felicity condition. See Alonso-Ovalle and Menéndez-Benito 2013 for a summary and comparison of the two main approaches to epistemic indefinites.
Spanish *algún*. In §4 I turn to Tiwa’s -*khi* indefinites, demonstrating that they show exceptional wide scope, and proposing a choice functional analysis with existential closure that accounts for this. I also show why Alonso-Ovalle and Menéndez-Benito’s analysis cannot be extended to -*khi* indefinites. In §5 I discuss the range of epistemic readings available to -*khi* indefinites and suggest that their epistemic effects result from existential quantification over choice functions, through competition with indefinite and definite alternatives. I conclude in §6, and consider the crosslinguistic implications of this analysis.

2. Epistemic indefinites in Tiwa

Tiwa’s two series of epistemic indefinites are formed through suffixation of either -*pha* or -*khi* to an indeterminate base, glossed as a *wh*-word throughout. (In its bare form, the indeterminate base functions as a *wh*-word.) These indefinites can function either as an article, or as an independent pronoun. For an analysis of the internal composition of these indefinites, and discussion of Tiwa’s indeterminates more generally, see Dawson to appear.

(4) *Tiwa’s epistemic indefinites*

<table>
<thead>
<tr>
<th>base gloss</th>
<th>-<em>khi</em></th>
<th>-<em>pha</em></th>
</tr>
</thead>
<tbody>
<tr>
<td>who</td>
<td>shar-kh’í</td>
<td>shar-pha</td>
</tr>
<tr>
<td>what</td>
<td>inda-khí</td>
<td>inda-pha</td>
</tr>
<tr>
<td>where</td>
<td>pajíang-khí</td>
<td>pajíang-phá</td>
</tr>
<tr>
<td>where</td>
<td>pathó-khí</td>
<td>pathó-pha</td>
</tr>
<tr>
<td>when</td>
<td>pakhál-khí</td>
<td>pakhál-phá</td>
</tr>
<tr>
<td>how</td>
<td>padi-khí</td>
<td>padi-pha</td>
</tr>
<tr>
<td>how much</td>
<td>pasí-khí</td>
<td>–</td>
</tr>
<tr>
<td>which</td>
<td>pakhá-khí</td>
<td>pakhá-pha</td>
</tr>
</tbody>
</table>

As shown in §1, both -*pha* and -*khi* indefinites cannot be felicitously followed by an identification of the witness (examples (1) and (2)), in contrast to the plain indefinite (example (3)). This infelicity is due to the fact that both -*pha* and -*khi* indefinites strongly convey speaker ignorance with respect to the witness. In both cases, this ignorance arises as a conversational implicature: the effects can be cancelled, reinforced, and, in the case of -*pha* indefinites, it disappears in downward-entailing environments.

2.1. Conversational implicature

The epistemic effects associated with both -*pha* and -*khi* indefinites behave like a conversational implicature. The first piece of evidence for this is that in both cases the implication of speaker ignorance can be canceled if there is some other reason to use an indefinite (e.g., if the speaker does not want to identify the witness). This is shown for -*pha* in (5) and (6). In both examples, the speaker follows an assertion with a -*pha* indefinite by explicitly stating that she can identify the witness.

In addition to the morphologically transparent form *shar-khí*, there are various allomorphs for the human -*khi* indefinite, including *sharkhíne*, *shargíne*, *sharkhídi*, and *shagídi* (see Joseph 2014).
Cancelation for -khi is shown in (7) and (8). In (7), the speaker knows who she will marry, but does not want to tell the addressee who it is. The preceding context of (8) is that there is a man who is constantly bothering the speaker, which includes always asking her invasive questions about her recent activities. The speaker replies to a question about when she went to Guwahati, with the sentence in (8): she is explicitly withholding information.

(7) Ang shar-khí-na-rê phadé-w, thêbo ang sông-ya shar-a-re.
1SG who-KHI-DAT-COM marry-NEUT but 1SG tell-NEG who-DAT-COM
‘I’m going to marry someone, but I won’t tell you who.’ [2017.1.84]

when-KHI go-PST 1SG know-NEUT when but 2SG,DAT tell AUX-NEG
‘I went sometime. I know when, but I won’t tell you.’ [2017.2.7]

Note that the ignorance implicature for -khi indefinites is harder to cancel than it is for -pha indefinites. While the ignorance component of -pha can be canceled by simply adding “I know who” as shown in (5), this same strategy is judged infelicitous for -khi:

(9) Maria shar-khí-gô lak mán-ga, # arô shar-go ang si-w.
Maria who-KHI-ACC meet-PFV but who-ACC 1SG know-NEG
‘Maria met someone, # and I know who.’ [2016.1.88]

In addition to cancelation, the ignorance component of both series of indefinites can be reinforced without redundancy, showing that ignorance is not part of the asserted content. Reinforcement is shown for -pha in (10) and for -khi in (11).

Maria who-PHA-ACC meet-PFV but who-ACC 1SG know-NEG
‘Maria met someone, but I don’t know who.’ [2016.1.88]

Maria who-KHI-ACC meet-PFV but who-ACC 1SG know-NEG
‘Maria met someone, but I don’t know who.’ [2016.1.88]

A type of evidence for conversational implicature comes from behavior in downward-entailing contexts: when an epistemic indefinite scopes under negation or a conditional operator, for example, the epistemic effect is lost. This is shown for negation in (12) and for a conditional in (13). In these two sentences, which feature -pha indefinites, there is no epistemic effect.

(5) Maria shar-phá-go lak mán-ga, arô shar-go ang si-w.
Maria who-PHA-ACC meet-PFV and who-ACC 1SG know-NEUT
‘Maria met someone, and I know who.’ [2016.1.88]

(6) Shar-phá phi-dom. Ang pro little si-w, thêbo ná pro little si-ya.
who-PHA come-PST 1SG 3SG know-NEUT but 2SG 3SG know-NEG
‘Someone came. I know him, but you don’t.’ [2016.2.41]

(12) Maria shar-khí-gô lak mán-ga, # arô shar-go ang si-w.
Maria who-KHI-ACC meet-PFV but who-ACC 1SG know-NEG
‘Maria met someone, # and I know who.’ [2016.1.88]

Maria who-KHI-ACC meet-PFV but who-ACC 1SG know-NEG
‘Maria met someone, but I don’t know who.’ [2016.1.88]
(Indeed, it is difficult to imagine what an epistemic effect would look like when the indefinite is in a downward-entailing context, such as embedded under negation or a conditional operator.)

(12) [Cp Shar-pha phi-dom honmandé ] thángane cha.
    who-PHA come-PST COMP correct NEG
    ‘It’s not correct that someone came.’ [2016.2.42]
    ✓: Nobody came.

(13) Chidi shar-pha sister lak mán-a phi-gaido, Saldi khúp khâdu-gam.
if who-PHA sister meet-INF come-COND Saldi very happy-CF
    ‘If Saldi meets some nun, she would be very happy.’ [2016.1.131]
    ✓: Meeting any nun will make Saldi happy.

Note, though, that this test cannot be applied to -khi indefinites, since they necessarily take wide scope over all other operators, including from inside islands. I return to this point in §4.

3. -pha indefinites

In the previous section, I showed that the speaker ignorance component associated with both -khi and -pha indefinites behaves like a canonical conversational implicature: it is cancelable and reinforceable, and, in the case of -pha indefinites, disappears in downward-entailing environments. In this section, show that just like Spanish algún, -pha indefinites must range over a non-singleton domain. I propose that Alonso-Ovalle and Menéndez-Benito’s (2010) analysis be extended to -pha indefinites.

3.1. -pha indefinites have an anti-singleton constraint

Tiwa’s -pha indefinites have an anti-singleton constraint, similar to the one described for Spanish algún (Alonso-Ovalle & Menéndez-Benito 2010). This is most clearly illustrated in the contrast between (14) and (15), in which an indefinite combines with the restrictor ‘pope’. There is only one pope: the extension of Pha Khúmur is a singleton. The plain indefinite, which has no domain restrictions, is felicitous in such cases, as shown in (14), while -pha indefinites are infelicitous, as shown in (15).

(14) Ang sája Pha Khúmur-go lak mán-a lí-do.
    1SG one.CL father holy-ACC meet-INF go-IPFV
    ‘I’m going to meet a pope.’ [2017.1.29]

(15) #Ang shar-pha Pha Khúmur-go lak mán-a lí-do.
    1SG who-PHA father holy-ACC meet-INF go-IPFV
    Intended: ‘I’m going to meet some pope.’ [2017.1.29]
    Comment: Because Pha Khúmur is only one.

Note the absence of an anti-uniqueness effect for the plain indefinite (and also -khi indefinites; see §4), which we might have expected to arise through Maximize Presupposition in competi-
tion with the definite (Heim, 1991). If -pha indefinites carry an anti-singleton presupposition, as I propose below, the absence of this effect is expected: in using the plain indefinite, rather than the definite, the speaker has failed to presuppose that there is a unique referent. However, the speaker has also failed to employ the anti-singleton presupposition associated with the -pha indefinite. These presuppositions effectively cancel each other out, leaving the plain indefinite neutral with respect to its likely domain.

Further evidence for an anti-singleton constraint on -pha indefinites comes from examples like (16). This example was deemed infelicitous in an out of the blue context, where the extension of Indiane PM is understood to be the singleton set \( \{ \text{Modi} \} \). It becomes grammatical, however, in a context in which all living Indian prime ministers, past and present, are relevant: the domain is no longer a singleton.

(16) Ang shar-pha India-ne PM-go lak mán-a lí-do.
1SG who-PHA India-GEN PM-ACC meet-INF go-IPFV
‘I’m going to meet some Indian Prime Minister.’ [2016.2.101]
#: Out of the blue (there is only one PM: Modi)
✓: All past and present Indian PMs are contextually relevant (Modi, Singh, ...)

An anti-singleton constraint on -pha also straightforwardly explains the only gap found in the -khi and -pha series as outlined in the table in (4). Specifically, there is no -pha indefinite corresponding to the indeterminate pasí ‘how much’. If pasí picks out the maximal degree to which some property holds of an individual, this gap is explained: as there can only be one maximal degree, it follows that anti-singleton pasí-phâ would be an anomaly.

3.2. Deriving -pha’s epistemic effect

Tiwa’s -pha indefinites are similar to Spanish algún, which likewise has an anti-singleton constraint, and whose epistemic effects are a conversational implicature (Alonso-Ovalle and Menéndez-Benito, 2010). Accordingly, I propose to treat -pha indefinites in the same way as algún. Specifically, -pha indefinites carry a condition that their domain is not a singleton, as formalized in (17) following Alonso-Ovalle and Menéndez-Benito 2010.

(17) \[
[\text{Wh-pha}] = \lambda f_{(et,et)}, \lambda P_{(et)}, \lambda Q_{(et)}: \text{anti-singleton}(f). \exists x[f(P)(x) & Q(x)]
\]

When a speaker uses a -pha indefinite in an upward entailing environment, she necessarily makes a weaker statement than she would if she used a singleton alternative, such as a definite description, a name, or an indefinite that allows for a singleton domain. Consider the sentence in (18a).

(18) a. Maria shar-pha sister-go lak mán-ga.
    Maria who-PHA nun-ACC meet-PFV

A new kind of epistemic indefinite

‘Maria met some nun.’ [2016.2.63]

b. Assertion: □∃x[f(nun)(x) & meet(Maria)(x)]

c. Presupposition: | f(nun)|>1

In using *sharpha sister*, the speaker has explicitly signaled that the domain is a non-singleton, perhaps consisting of a set of three individuals {Lily, Irene, Filina}. By using *sharpha sister* in this case, the speaker is asserting that Maria met someone in that domain, as in (19a). But she could have asserted that Lily came, or that Irene came, or that Filina came. The hearer reasons that she did so to avoid a false claim: it’s not the case that Maria must have met Lily, and so on. This gives rise to the implicature in (19b): the speaker cannot truthfully make a stronger assertion because she doesn’t know if it’s true.

(19) a. □[met(Lily)(Maria) ∨ met(Irene)(Maria) ∨ met(Filina)(Maria)]

b. ¬□[met(Lily)(Maria)] & ¬□[met(Irene)(Maria)] & ¬□[met(Filina)(Maria)]

Kratzer and Shimoyama (2002) and Alonso-Ovalle and Menéndez-Benito (2010) show that a different pragmatic reasoning must take place under possibility modals to derive the ignorance implicature, since one of the singleton alternatives is necessarily true. They propose that in these cases, the hearer reasons that the speaker has used the non-singleton alternative to avoid a false exhaustivity inference. Specifically, a stronger singleton alternative under a possibility modal would lead the hearer to draw an exhaustivity inference (♢p implies ¬♢q). The hearer reasons that the speaker is avoiding this inference by using a non-singleton: neither ♢p nor ♢q are ruled out. Again this implicates speaker ignorance. See Kratzer and Shimoyama (2002) and Alonso-Ovalle and Menéndez-Benito (2010) for more detailed discussion of this analysis.

Importantly, the ignorance implicatures disappear in downward entailing environments such as negation and conditionals, because in using an indefinite with a non-singleton domain the speaker has made a stronger statement. The analysis sketched above derives the epistemic effects of -pha indefinites from an independent fact of their semantics (that they require a non-singleton domain), and explains why the effects are cancelable and disappear in downward entailing environments. The Tiwa data provides another clear example of an anti-singleton indefinite that has exactly the behaviors expected of such an indefinite.

4. -khi as a wide scope indefinite

Tiwa’s -pha indefinites are generalized existential quantifiers: they can scope above or below other operators, and resist scoping out of islands (possibly due to their antisingleton constraint (Schwarzschild, 2002)), as shown below in (26) and (27). Tiwa’s -khi indefinites, in contrast, take obligatory wide scope over all other operators, including from inside islands. Examples (20)-(23) show wide scope with respect to clausemate negation, a universal quantifier, a deontic necessity modal, and an attitude verb, respectively.

(20) Maria inda-khí kashónɡ pre-ya-m.

Maria what-KHI dress buy-NEG-PST

‘Maria didn’t buy some dress.’ [2016.1.130]

✓: There’s a particular unknown dress Maria didn’t buy.  ⊤ > ¬
#: There were no dresses. *

(21) Sogól-lò  inda-khí  hat-a  lí-ga.
    everyone-FOC  what-KHI  market-DAT  go-PFV
    ‘Everyone went to some market.’ [2016.1.133]

✓: Everyone went to a particular, unknown market.  ∃ > ∀

#: Each person went to a different market. *

(22) Maria shar-khí  sister-go  lak mán-a  mán-o.
    Maria who-KHI  sister-ACC  meet-INF  must-NEUT
    ‘Maria has to meet some nun.’ [2016.2.52]

✓: There is a particular nun, unknown to the speaker, that Maria has to meet.  ∃ > □

#: Maria needs to meet with any nun. *

(23) Ang [ shar-khí  Delhi-jíng  shó-wa  mewâ-go ]DP  phád-e-na  hal-do.
    1SG  who-KHI  Delhi-ALL  reach-NMLZ  man-ACC  marry-INF  want-IPFV
    ‘I want to marry some man that’s been to Delhi.’ [2016.2.120]

✓: The speaker saw him the other day, but hasn’t actually met him.  ∃ > want

#: The speaker wants to marry any man that’s been to Delhi. * want > ∃

Examples (24) and (25) show that -khi indefinites must scope out of islands, shown here with a finite embedded clause and a conditional antecedent, respectively.9

(24) [ Shar-khí  phi-dom  honmandé ]CP  thângane cha.
    who-PHA  come-PST  COMP  correct  NEG
    ‘It’s not correct that someone came.’ [2016.2.42]

✓: There’s a particular person, unknown to the speaker, that didn’t come.  ∃ > ¬

#: Nobody came. * ¬ > ∃

    if  who-KHI  sister-ACC  meet-INF  come-COND  Saldi  very  happy-CF
    ‘If Saldi meets some nun, she would be very happy.’ [2016.1.131]

✓: There is a particular nun, unknown to the speaker, that Saldi wants to meet.  ∃ > if

#: Meeting any nun will make Saldi happy. * if > ∃

That these environments are scope islands in Tiwa is evidenced by the fact that -pha indefinites cannot scope out of them, as shown in (26) and (27). They are also islands for overt syntactic movement (see Dawson to appear).

(26) [ Shar-pha  phi-dom  honmandé ]CP  thângane cha.
    who-PHA  come-PST  COMP  correct  NEG
    ‘It’s not correct that someone came.’ [2016.2.42]

✓: Nobody came.  ¬ > ∃

9Relative clauses, omitted here for reasons of space, are also scope islands and behave as expected: -khi indefinites must scope out of them.
A new kind of epistemic indefinite

#: There’s a particular person that didn’t come. * ∃ > ¬

(27) Chidī shar-phā sister lak mān-a phi-gaido, Saldi khūp khādū-gam. if who-PHA sister meet-INF come-COND Saldi very happy-CF ‘If Saldi meets some nun, she would be very happy.’ [2016.1.131]
✓: Meeting any nun will make Saldi happy. if > ∃
#: There is a particular nun that Saldi wants to meet. *∃ > if

This obligatory, island-violating wide scope that -khi exhibits brings to mind a definite or other referring expression. Examples like (28), however, show that -khi pronouns/articles are indefinite: this sentence is not a contradiction.10 Further evidence comes from -khi’s acceptability in sluicing, as (11) shows in §2 above.

(28) Shar-khī margī rojā-ga, arō shar-khī margī rojā-ya-m. who-KHI woman sing-PFV and who-KHI woman sing-NEG-PST ‘Some woman sang, and some woman didn’t sing.’ [2017.2.4]

To account for -khi indefinites’ scope behavior, I adopt a choice functional analysis (Winter, 1997; Reinhart, 1997; Kratzer, 1998). I propose that -khi indefinites introduce a choice function which ranges over the property denoted by their restrictor, as shown in the denotation in (29).11 This variable is subject to obligatory existential closure at the highest level (Matthewson, 1999).12

(29) [wh-khi] = λP. f(P), where f is a CF

Existential closure of the choice function variable derives widest scope. This is illustrated in (30a) for the sentence in (30b) (repeated from (20) above).13

(30) a. ∃[CH(f) & ¬buy(Maria)(f(dress))]
   b. Maria inda-khī kashōng pre-ya-m. Maria what-KHI dress buy-NEG-PST ‘Maria didn’t buy some dress.’ [2016.1.130]
      ✓: There’s a particular unknown dress Maria didn’t buy. ∃ > ¬
#: There were no dresses. * ¬ > ∃

10By contrast, a bare noun in this sentence does result in a contradiction, as in (i). (Bare nouns in an external argument position in Tiwa are interpreted as definite.)
(i) #Korkhyā lukhāi thā-ga, arō korkhyā lukhāi thā-ya-m. child hide AUX-PFV and child hide AUX-NEG-PST ‘The child hid, and the child didn’t hide.’ [2017.2.5]
11I assume that -khi indefinites that appear without an overt NP have an implicit restrictor.
12For the sake of simplicity I abstract away from whether this is a Skolemized choice function or not, and assume that this closure takes place at the highest level (cf. Chierchia 2001 and Schwarz 2001). The data that would bear on these questions are unclear at this stage. As far as I can tell, if necessary, these modifications would not make a difference to the pragmatic account sketched here.
13In the remainder of this paper I omit the covert assertoric operator that was included in §3 since it is not directly bear on the analysis of -khi indefinites. If it were included, it would out-scope existential closure of the choice function variable.
Because this existential closure can occur at an arbitrary distance from the variable itself, this analysis captures -khi indefinites’ island-violating scopal behavior.

4.1. Evidence for existential closure

Choice functional analyses do not always involve existential closure of the choice function variable. Kratzer (1998) proposes that instead the variable is left free: a seemingly wide scope indefinite is actually a specific indefinite, with the variable subject to a contextually determined assignment.14 Crucially, the value of the choice function variable does not need to be known to the hearer: instead, it is sufficient for the speaker to have a particular witness is mind. By contrast, Matthewson (1999) argues for wide existential closure of choice function variables based on data in St’át’imcets. She argues that speakers of St’át’imcets do not need to have a specific witness in mind when using a wide scope indefinite: sentences involving St’át’imcets indefinites are true and felicitous if there is any witness that fulfills the proposition. These data are explained if the variable is existentially closed.

The behavior of Tiwa’s -khi indefinites favors an analysis that involves existential closure. As Matthewson argues for St’át’imcets, Tiwa speakers do not have to have a specific witness in mind in using a -khi indefinite. This is shown in the examples below. First, in (31), a -khi indefinite is used in a counterfactual conditional: Lastoi, who is unmarried, did not go to Spain, but the speaker believes that if she did, she would have married someone. The speaker does not have a particular individual in mind in making this existential claim.

  ǐf 资管 Lastoi Spain-ALL go-CF.COND 3SG who-KHI-COM marry-CF
  ‘If Lastoi had gone to Spain, she would have married someone.’ [2017.1.55]
  = There is someone such that if Lastoi had gone to Spain, she would have married him.

In (32), the speaker conveys that there is a Mizo man she would like to marry, but she doesn’t have a particular one in mind. Based on the fact that she generally finds Mizo men attractive, she knows that such a man exists.

(32) Ang shar-khí Mizo mewá-re pháde-na as hóng-do, thêbo ang sája Mizo
  1SG who-KHI Mizo man-COM marry-INF desire-IPFV but 1SG one.CL Mizo
  mewá-go-bo  lák mán-an’ cha. Pâdi rí-w?
  man-ACC-ADD meet-NMLZ NEG how do-NEUT
  ‘I want to marry some Mizo man, but I’ve never met a Mizo man before. What will I do?’ [2017.2.6]
  = There is a Mizo man such that I want to marry him, but I don’t know which one.

These data show that, at the very least, Tiwa’s -khi indefinites differ from indefinites like En-

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14 Under her analysis, indefinites that take local scope are generalized existential quantifiers. Apparent intermediate scope examples involving island violations are instances of pseudo-scope due to a covarying argument of the choice function that is bound by a higher quantifier.
glish a certain, for which the speaker does plausibly have a witness in mind. If indefinites like a certain are to be analyzed as free-variable choice functions (Kratzer, 1998; Schwarz, 2001), positing existential closure for Tiwa’s -khi indefinites both captures their truth conditions and provides an explanation for their different readings. As discussed in §5 below, it is also crucial in explaining why speaker ignorance is implicated for -khi indefinites.

4.2. Singleton domains

The analysis of -khi indefinites provided in this section does not place any restrictions on the domain that a -khi indefinite can range over. Specifically, the choice function variable that the -khi indefinite introduces should be able to range over either a singleton or a non-singleton domain: if it ranges over a singleton, any value of \( f \) will simply select the same individual. This prediction of the analysis is borne out. Unlike -pha indefinites, -khi indefinites can range over singleton domains. This is shown for the inherently singleton restrictor ‘pope’ in (33). Contrast this with the -pha indefinite version in (15) in §3 above. Using sharkhi in this sentence does not yield the same infelicity that using sharpha does.

(33) Ang shar-khí Pha Khûmur-go lak máń-a lí-do.
1SG who-KHI father holy-ACC meet-INF go-IPFV
‘I’m going to meet some pope.’ [2017.1.28]

Another example is given in (34). Here the -khi indefinite ranges over the set of countries called Zambia (presumably a singleton set, even for someone who has never heard of it before).

Mukton where-KHI Zambia say-NMLZ country-DAT go-PFV
‘Mukton went to some country called Zambia.’ [2017.1.141]
Context: Mukton went to Zambia. He told me, but I’ve never heard of Zambia before.

That -khi indefinites freely range over singleton sets rules out an analysis of their epistemic effects along the lines of that in Alonso-Ovalle and Menéndez-Benito 2010 and §3 above. Instead, these effects must be derived differently.

5. -khi’s epistemic effects

The epistemic effects associated with -khi indefinites are highly salient. While they can be canceled, given the right context (see examples (7) and (8) above), the sense that the speaker is ignorant about the witness in some way is extremely strong. Indeed, speaker translations of sentences containing a -khi indefinite frequently contain a reference to speaker ignorance. This ignorance, however, is not limited to whether the speaker can name (or otherwise clearly identify) the witness. Instead, -khi indefinites can convey speaker ignorance with respect to essentially any salient property. This range of ignorance readings is clearly shown in examples like (35). (35a) shows that this sentence cannot be felicitously followed simply with an indication that the speaker is familiar with the witness. This is expected, given -khi’s epistemic effect. However, (35b) shows the speaker can in fact follow a -khi indefinite with an indication
of familiarity, provided there is some other reason to use the epistemic indefinite. In this case, the speaker can’t remember what color hair her friend has.

(35) Ang shar-khí chor-go lak máñ-a lí-do...
    1 SG who-KHI friend-ACC meet-INF go-IPFV
    ‘I’m going to meet some friend (of mine) . . . ’ [2017.2.6]
   a. #Pe áí kró-wa chor.
       3 SG 1 SG.GEN good-NMLZ friend
       ‘He’s a good friend of mine.’
   b. Pe áí kró-wa chor, thëbo ang pe-ne khuní-ne ajár-go
       3 SG 1 SG.GEN good-NMLZ friend but 1 SG 3 SG.GEN hair-GEN color-ACC
       plaw-ga. (Pegâne angá pe-go pishár-a sásti hón-o.)
       forget-PFV therefore 1 SG.DAT 3 SG-ACC search-NMLZ trouble COP-NEUT
       ‘He’s a good friend of mine, but I forgot what color his hair is. (So I’m going to have trouble searching for him.)’

This freedom of what kind of ignorance -khi can convey is also evident in the singleton domain examples like (36). This sentence is felicitous in a case in which the speaker knows who the Indian Prime Minister is (in the sense that she knows he is the man called Narendra Modi), but she has never met him before.

(36) Ang shar-khí India-ne PM-go lak máñ-a lí-do.
    1 SG who-KHI India-GEN PM-ACC meet-INF go-IPFV
    ‘I’m going to meet some Indian Prime Minister.’ [2016.2.80]
   ✓: The speaker hasn’t met him before, but she knows he’s Narendra Modi.

A similar range of ignorance effects are conveyed with the inherently singleton examples in §4.2. The pope example in (33) conveys that the speaker is unfamiliar with the pope, whether that is because she has never met him, or because she doesn’t know who he is. In (34), while the speaker clearly knows the name of the country Zambia, she is otherwise completely unfamiliar with it. The generalization in all the examples is that the speaker must be ignorant about some contextually relevant property of the witness, whether that’s his hair color, his name, or something else.15

For Aloni and Port (2015), this variability in kinds of speaker ignorance is central to understanding epistemic indefinites. The key observation is that what it means to identify a witness will vary in different contexts. That is, in one context it might be sufficient to be able to name the witness without knowing anything else about it, but in another it might be sufficient to describe a witness, without knowing its name. Couched in conceptual covers (Aloni, 2001), such as naming, ostension, and description, Aloni and Port’s analysis is that epistemic indefinites are indefinites that are only licensed when there is a shift in the conceptual cover being used to identify the witness. This style of analysis captures a key fact of Tiwa’s -khi indefinites: in

15Like Japanese -ka indefinites (Alonso-Ovalle and Shimoyama, 2014), the wh-base of the indefinite plays a role in the kind of ignorance that is conveyed: for inanimates, inda-khi “what-KHI” conveys ignorance with respect to type of the witness, while pakha-khi “which-KHI” conveys ignorance with respect to token. This seems to be independent of the variation in what counts as speaker ignorance in a given context.
most cases, -khi indefinites convey that the speaker cannot identify the witness by some salient property. Aloni and Port’s analysis treats the epistemic component of the indefinite as a felicity condition associated with the lexical item itself. Given the data in §2 above, I propose that we treat the epistemic effects associated with -khi indefinites as a conversational implicature, rather than a felicity condition, but draw on Aloni and Port’s insights regarding how the witness is identified in a given context.

Instead of positing a felicity condition, I suggest that ignorance with respect to a salient property of the witness is implicated by means of the choice functional nature of -khi indefinites. A choice function is a function that picks out an individual from a set. That choice function could reflect any property. For example, as applied to the set of my friends, it could reflect the property of having red hair. It could also reflect the property of being named Narendra Modi. Depending on the set in question, the property that will uniquely select an individual will vary: in a set otherwise of black-haired individuals, the function $\lambda x. \text{has-red-hair}(x)$ will select my red-headed friend Monbor. But in a set of red-haired individuals, a different function will be needed. In §4, I proposed that -khi indefinites are choice functional in order to derive their scope facts. Here, I suggest that this choice functional nature, combined with existential closure of the choice function variable, is exactly how their epistemic effects arise.

In all the cases discussed here, the speaker could have used a definite (or other referring expression) in place of a -khi indefinite to make a stronger statement. She did not. In using an indefinite (that is, in existentially quantifying) she already potentially implicates ignorance, to the extent that any existential quantification does (including other non-epistemic indefinites like English $a$). But the epistemic effects that -khi gives rise to are stronger than this sort of weak ignorance. Crucially, a -khi indefinite is not the only way to existentially quantify in Tiwa. Instead, the speaker could have used either a plain indefinite or a -pha indefinite. Consider the following sentence, repeated in part from (1) above:

(37) a. Shar-khi phi-dom.
    who-KHI come-PST
    ‘Someone came.’ [2017.1.81]
b. $\exists x[\text{CH}(x) \land \text{came}(x)]$

Instead of uttering (37a), the speaker could have uttered either (38a) or (39a), which would have resulted in (near) equivalent truth conditions.

(38) a. Sája ifbing phi-dom.
    one.CL person come-PST
    ‘A person came.’ [2017.1.81]
b. $\exists x[\text{human}(x) \land \text{came}(x)]$

(39) a. Shar-pha phi-dom.
    who-PHA come-PST
    ‘Some person came.’ [2017.1.81]
b. $\exists x[f(\text{human})(x) \land \text{came}(x)], \text{where } |f(\text{human})| > 1$
Both these alternate strategies involve existential quantification directly over individuals. (The difference between the two, recall, is that -pha presupposes a non-singleton domain, while the plain indefinite has no domain requirements.) Where these alternatives involve direct existential quantification over individuals, a -khi indefinite involves a higher order quantification: existential quantification over choice functions that range over individuals. A listener might wonder why the speaker has chosen this indirect route, where obvious alternatives were available.

Importantly, this reasoning holds in different scope scenarios: the plain indefinite can also (but need not) take island-violating wide scope, allowing it to serve as a competitor to -khi indefinites in all cases. This wide scope is shown in (40) for a conditional island (compare to the -khi indefinite in (25) and the island-bound -pha indefinite in (27)).

(40) Lastoi sája ticher-go pasē-gaidō, ɪf-w.
   Lastoi one.CL teacher-ACC speak-COND go-NEUT
   ‘If Lastoi talks to a teacher, she will leave.’ [2017.1.156]
   ✓: Lastoi needs to get permission from a particular teacher in order to leave school early; no other teacher can grant her permission.  ∃ > if

I suggest that the use of a choice functional indefinite explicitly highlights different ways of selecting an individual from a set. That is, invoking choice functions brings up the various possible ways of selecting the individual: it could be by name, by ostension, or even by hair color. Importantly, the speaker existentially quantifies over the choice function variable introduced by -khi. A sentence containing a -khi indefinite literally asserts that there is a way of selecting an individual from the domain such that the predicate holds of that individual. Since the speaker didn’t use a definite (or otherwise specify how the individual can be selected), this implicates ignorance about not the witness itself, but the way that the witness is to be selected.

This account crucially relies on existential quantification over the choice function variable. In §5 I contended that there is evidence independent of epistemic effects to posit this closure in Tiwa, namely, the speaker does not have to have a particular witness in mind. This contrasts with another wide scope indefinite, English a certain, which Kratzer (1998) analyzes as choice functional without existential closure. The behavior of a certain fits with this analysis: in using a certain the speaker does indeed seem to have a particular individual in mind. A certain also does not result in the kinds of ignorance effects see above for Tiwa’s -khi indefinites. If -khi indefinites do involve obligatory existential closure, while the choice function variable introduced by a certain is left free, these differences are straightforwardly explained.16

The epistemic effects associated with -khi indefinites, then, plausibly arise as a natural consequence of their narrow semantics in competition with other elements in the system. The wide range of ignorance readings is a result of the choice function variable that -khi introduces. This type of competition does not, however, result in a more familiar quantity implicature: both -khi indefinites and their more direct indefinite alternatives result in equally strong statements. Instead, the result of this competition is closer to a manner implicature.

16This suggestion is related to Schwarz’s (2001) observation that not all wide scope indefinites behave the same way, and that a unified analysis is not necessarily desirable.
6. Conclusion

In this paper, I have provided a description of Tiwa’s two series of epistemic indefinites. One of these series, the -pha indefinites, bears an anti-singleton constraint similar to Spanish algún and likewise shows similar, cancelable epistemic effects. Tiwa’s -pha indefinites thus provide cross-linguistic support for Alonso-Ovalle and Menéndez-Benito’s (2010) account of how the epistemic effects of Spanish algún arise (i.e., that they are related to domain requirements). Tiwa’s other series of epistemic indefinites, the -khi series, always take widest scope, and are best analyzed as introducing a choice function that is existentially closed above other operators. I suggest that the epistemic effects associated with Tiwa’s wide scope indefinites arise as a direct result of this quantification over choice functions, in competition with Tiwa’s other indefinites (and with stronger, definite alternatives). This account relies on the understanding that -khi indefinites involve a higher order quantification over functions, rather than individuals, which leads to an ignorance implicature about the way an individual can be identified. There is a close connection between this higher order ignorance implicature, and Aloni and Port’s (2015) felicity conditions which involve shifts in conceptual covers.

6.1. Crosslinguistic predictions

The account of -khi indefinites’ epistemic component sketched in §5 makes a key crosslinguistic prediction. Namely, if the epistemic effects arise as a consequence of general Gricean reasoning, we would expect to find them in any language with a sufficiently similar system. In the remainder of this conclusion, I will provide an initial evaluation of this prediction.

Choice functional analyses of wide scope indefinites have been proposed for various languages. These include English a certain (Kratzer, 1998), the wide scope reading of English a (Reinhart, 1997; Kratzer, 1998),17 St’át’imcets indefinites (Matthewson, 1999), and the Russian -to series (Yanovich, 2005), among others. However, not every wide scope indefinite triggers the kind of salient epistemic effects found with Tiwa’s -khi indefinites. Among the choice functional indefinites listed here, only the Russian -to series has been reported to convey speaker ignorance (Kagan, 2011). I will consider each of these in turn, beginning with English, and suggest how the presence or absence of epistemic effects is compatible with the account sketched above.

First, as discussed in §5 above, if English a certain is choice functional, but lacks existential closure of the choice function variable (Kratzer, 1998), we expect there to be no ignorance effect. The speaker has not existentially quantified over choice functions (which implicates ignorance about the witness to that quantification), but left the variable free. As Kratzer notes, it seems sufficient in this case for the speaker to have a specific witness in mind. If this is correct, we expect a certain to not give rise to speaker ignorance. The situation is more complicated for the plain English indefinite a. Under a Kratzer-style analysis, the choice function variable that a introduces (when it takes exceptional wide scope) is left free. If this is the case, then again we do not expect ignorance effects. If, however, the choice function variable is existentially closed

17 Reinhart (1997) analyzes all instances of English a as choice functional, with existential closure occurring at different levels. Kratzer treats a as ambiguous between a generalized quantifier and choice functional indefinite.
in these cases (Reinhart, 1997), then we might expect ignorance effects to arise. It is however possible that wide scope English \textit{a} is not a choice functional indefinite at all, but rather, as Schwarzschild (2002) proposes, that exceptional wide scope might arise solely through domain restriction to a singleton (i.e. exceptional scope \textit{a} still involves quantification directly over individuals). If his account is correct, then the absence of ignorance effects with wide scope \textit{a} are expected.

In contrast to English \textit{a certain}, St’át’imcets choice functional indefinites do seem to involve existential closure of the choice function variable (Matthewson, 1999), but do not seem to give rise to speaker ignorance effects. Matthewson does not explicitly discuss epistemic effects associated with St’át’imcets wide scope indefinites. Such effects are also not reflected in the various speaker comments associated with example sentences, or in the contexts that allow for a felicitous use of the indefinites. While this in itself does not entail that such epistemic effects are not present, it is suggestive of a difference between Tiwa’s \textit{-khi} indefinites and St’át’imcets’ wide scope indefinites. Exploring the scope and other properties of Tiwa’s \textit{-khi} indefinites lead to consistent consultant commentary (independently, by multiple consultants) on their epistemic effects, to the point where \textit{sharkhidi} “someone” [2016.2.52] was offered as a translation for the English word “stranger”. Further, Matthewson discusses data that suggest that the speaker does not convey ignorance with respect to the witness in using a choice functional indefinite in St’át’imcets, as in (41).

(41) Context: Rose goes to the store and asks the salesperson for a copy of the book \textit{False Crow}. The salesperson gives her a book in a bag, and Rose pays for it. When she gets home, she tells her daughter:

\begin{itemize}
  \item \textit{tecwp-kán }[\text{ta } \text{púkw-}a]
  \text{buy-1SG.SUBJ [DET book-DET]}
  \textit{I bought a book.’} (Matthewson, 1999: 124)
\end{itemize}

St’át’imcets wide scope indefinites then are both choice functional with existential closure, and seem not to convey speaker ignorance with respect to the witness. This, however, does not pose a problem for the account given above for Tiwa, which is based in general Gricean reasoning, due to differences in the overall system of determiners. Specifically, Tiwa’s choice functional indefinites give rise to ignorance implicatures due to competition with the plain indefinite: a generalized existential quantifier that can occur in the same environments as \textit{-khi} indefinites. St’át’imcets lacks such a competitor: the only non-choice functional determiner (\textit{ku}) is licensed only under negation, a modal, a conditional operator, or a question operator (Matthewson 1999). It takes obligatory narrow scope with respect to these operators, and is not licensed in a plain declarative. Consequently, St’át’imcets choice functional indefinites are never in competition with a plain indefinite.\textsuperscript{18} St’át’imcets thus provides a case of a language which has the same kind of choice functional indefinite as Tiwa (i.e. one that involves existential quantification), but does not give rise to ignorance implications due to differences in the set of competitors.

Finally, we are left with the question of whether there are languages in addition to Tiwa that

\textsuperscript{18}As Matthewson (1998) argues, St’át’imcets also lacks definite determiners.
have the necessary conditions (that is, both existentially closed choice functional indefinites, and suitable competitors) that show similar effects. While in-depth further research will be necessary to determine whether this is the case, I want to conclude by discussing a possible candidate. Russian has a series of wide scope indefinite determiners (the -to series) that are similar to those in Tiwa: they take exceptional wide scope. Yanovich (2005) analyzes these indefinites as choice functional (specifically providing a compositional account of the internal structure of the determiners in a Hamblin semantics). He adopts a Kratzer-style analysis in which the choice function variable is left free, rather than existentially closed. While this may be the correct analysis for -to indefinites, it’s worth noting that these indefinites do give rise to a strong sense of speaker ignorance. Kagan (2011) provides a detailed description of these ignorance effects, framing them in terms of speaker identifiability: in using a -to indefinite, the speaker has signaled that she cannot identify the witness. Importantly, what counts as identifiability is highly context dependent, as Kagan (2011: 60) notes: “In some cases, knowing a person’s name or how the person looks is sufficient. In others, knowledge of additional details is required.” Kagan provides an analysis of the ignorance effects of -to pronouns as a conventional implicature in terms of scope relative to quantification over possible worlds. While a more detailed comparison between Russian -to indefinites, Tiwa -khi indefinites, and the two systems as a whole remains to be done, it is possible that Russian provides another instance of a Tiwa-like wide scope epistemic indefinite.

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Counterfactual donkeys don’t get high
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Abstract. I present data that suggest the universal entailments of counterfactual donkey sentences aren’t as universal as some have claimed. I argue that this favors the strategy of attributing these entailments to a special property of the similarity ordering on worlds provided by some contexts, rather than to a semantically encoded sensitivity to assignment.

Keywords: donkey sentences, counterfactuals, conditionals, similarity, simplification.

Many indicative donkey sentences have universal entailments by default. From the truth of an utterance of (1), for instance, we can normally infer the truth of sentences like those in (2).

(1) If Balaam owns a donkey, he beats it.
(2) a. If Herbert is a donkey Balaam owns, Balaam beats Herbert.
   b. If Eeyore is a donkey Balaam owns, Balaam beats Eeyore.
   c. If Platero is a donkey Balaam owns, Balaam beats Platero.

The natural way to account for this is to give a semantics for indefinites, pronouns, and indicative conditionals on which (1) has a reading semantically equivalent to (3).

(3) \( \forall x((\text{donkey}(x) \land \text{Balaam-owns}(x)) \rightarrow \text{Balaam-beats}(x)) \)

This paper is about counterfactual donkey sentences, like (4).

(4) If Balaam owned a donkey, he would beat it.

Like their indicative counterparts, such sentences seem to have universal entailments. The truth of (4), for instance, seems to entail the following:

(5) a. If Herbert were a donkey Balaam owned, Balaam would beat Herbert.
   b. If Eeyore were a donkey Balaam owned, Balaam would beat Eeyore.
   c. If Platero were a donkey Balaam owned, Balaam would beat Platero.

The natural way to account for this is to give a semantics for indefinites, pronouns, and counterfactual conditionals on which (4) has a reading—a ‘high’ reading—which is semantically equivalent to (6).

(6) \( \forall x((\text{donkey}(x) \land \text{Balaam-owns}(x)) \Box \rightarrow \text{Balaam-beats}(x)) \)

1For helpful discussions of this material, thanks to Kyle Blumberg, Sam Carter, Simon Goldstein, Maribel Romero, Zoltán Gendler Szabó, Nadine Theiler, Tim Williamson, and especially Lucas Champollion, as well as to four anonymous reviewers, audiences at SuB22 and the Yale Semantics Reading Group, and the participants of Lucas Champollion’s Spring 2017 seminar at NYU on Counterfactuals and Inquisitive Semantics.

2Van Rooij (2006) is the first to pursue this strategy, as far as I know, though it’s similar to various attempts to give a semantics which validates simplification of disjunctive antecedents. The terminology is from Walker and Romero (2015), who follow van Rooij in this approach.
I will argue against this approach and defend the view that these entailments arise as a byproduct of a special kind of similarity ordering on worlds which the counterfactual conditional takes as an input from context. Counterfactual donkey sentences don’t get high readings, but only appear to because in many contexts, the default similarity ordering is of the relevant special kind.

We will proceed as follows. In §1, I lay out the relevant background, including the semantics to be defended (based on Wang (2009)), the criticism of it made by Walker and Romero (henceforth ‘WR’), and the competing kind of semantics van Rooij offers that gives counterfactual donkey sentences a high reading. In §2, I rebut WR’s criticism. I argue that even the amended semantics requires the kind of special ordering which they wish to reject. This undermines WR’s argument in favor of the competing account and against the original proposal. Further, I propose an account of the similarity relation which predicts the special ordering. Its tenability shows WR’s argument to be unpersuasive. Finally, in §3, I criticize the accounts that do allow high readings. Such accounts, I claim, make incorrect predictions in cases where the antecedent is actually satisfied—and only satisfied by things for which satisfy the consequent—but where the universal entailments do not hold for merely possible antecedent satisfiers. Intuitively, such sentences have no false readings, but on a high reading they would be false. Non-high-reading accounts which get high entailments through special ordering relations make the correct prediction in these cases. High reading accounts do not.

1. Background

There are various approaches to counterfactuals, indefinites, and donkey pronouns which we might try out in dealing with counterfactual donkey sentences. I will limit the current discussion to the ordering semantics approach to counterfactuals developed by Stalnaker and Lewis\(^3\) and dynamic binding approach to indefinites and donkey pronouns based on ideas in Groenendijk and Stokhof (1991) and Groenendijk et al. (1996).\(^4\) This is primarily because the extant explicit discussions of counterfactual donkey sentences in the literature—van Rooij (2006); Wang (2009); Walker and Romero (2015)\(^5\)—all use such theories.\(^6\) I would expect most of the central points I will make to carry over to other frameworks, but will not explore this here.

Let’s start with a review of ordering semantics. The basic components are a set of possible worlds \(W\) and for each world \(w\) a ‘similarity’ relation \(\leq_w\) over \(W \times W\). Intuitively, \(w_1 \leq w_0\) \(w_2\) means that \(w_1\) is more similar to \(w_0\) than \(w_2\) is (in a contextually relevant and currently theoretically underdetermined sense of ‘similar’) We’ll treat this set of similarity orderings as an element \(S\) of the model, which varies depending on the context of utterance.

\(^3\)See, e.g., Stalnaker (1968) and Lewis (1973).

\(^4\)As well as Heim (1982) and Kamp (1981), though less directly.

\(^5\)Though Walker and Romero ultimately propose, for reasons orthogonal to those discussed here, that we move to a dynamic-strict account of counterfactuals, along the lines of von Fintel (2001). Except for the occasional footnote, I will ignore this revision. Most of their discussion proceeds independently of it.

\(^6\)Other recent work on counterfactual donkey sentences includes Walker (2017) and Carter and Goldstein (ms), and came to my attention after I had written this paper. I hope to address these accounts in future work.
As we’ll see, what determines the similarity orderings, given a context, will differ from theory to theory. But like most semanticists using this framework, we will hold that it induces a partial order on $W$—that it is reflexive, transitive, and anti-symmetric. Further, we will assume that it is strongly centered—that for all $w, w'$, if $w \neq w'$, $w <_w w'$; each world is strictly closest to itself. And for ease of exposition, we will assume that similarity relations satisfy the limit assumption, which says that for any world $w$ and non-empty proposition $P$, there is a $w'$ such that $w' \in P$ and $w' \leq_w w''$ for any $w'' \in P$.

We give the semantics for a counterfactual conditional in two stages, first defining a selection function $f$, which given a sentence and a world will return the worlds closest to the given world at which the given sentence is true. Given similarity relations and an interpretation function $[\cdot]$ which returns a set of worlds for any sentence (namely, those worlds at which the sentence is true in the relevant model),

$$f(A, w) = \{w' : w \in [A] \land \neg \exists w''(w'' \in [A] \land w'' <_w w')\}. \tag{7}$$

Now we can state the truth conditions of a counterfactual conditional as follows:

$$[A \Box \rightarrow C] = \{w : \forall w'(w' \in f(A, w) \supset w \in [C])\} \tag{8}$$

In other words: $A \Box \rightarrow C$ is true at a world when all the worlds closest to it (according to the similarity relation of the context of utterance) at which $A$ is true are worlds at which $C$ is true.

Clearly, the meaning assigned to counterfactuals by this theory is heavily dependent on what determines the similarity orderings for a given context. To make substantive predictions about the truth-conditions of an utterance of a counterfactual, some details of how these orderings get determined must be provided.

For the moment we will follow the authors under discussion (van Rooij, Wang, WR) in relying on an intuitive notion of similarity in all respects. But throughout we should keep in mind the fact it is well known that this approach is inadequate. For the ordering semantics to get right cases like the famous one from Fine (1975), an intuitive notion of similarity will have to be replaced by something else.

$$a. \quad \text{If Nixon had pressed the button, there would have been a nuclear holocaust.}$$
$$b. \quad \text{If Nixon had pressed the button, the wire would miraculously malfunction.}$$

It’s easy to imagine scenarios where we want (9a) to come out true rather than (9b), even though a world where the button was pressed but the world was saved by a miraculous wire malfunction would be intuitively more similar to the evaluation world.

For a view on similarity which accounts for our judgments about this case and is closer to being tenable overall, I refer the reader to Lewis (1979), who proposes a system of weighted factors...

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7For discussion, see Lewis (1973: §§1.3–1.4, 2.3, 2.7). Strong centering for the ordering of worlds, it’s worth noting, is assumed by van Rooij, Wang, and WR.
that normally go into determining similarity. Roughly, the idea is that what’s most important
to determining similarity is the amount of widespread violation of physical laws (the fewer
miracles, the better). Overall similarity in matters of fact may matter, but only a little. This
should be enough to get us going, but we’ll come back to this issue in §2.1, where we introduce
a new proposal about how similarity is determined.

Now we’ll briefly outline the dynamic binding theory of indefinites and donkey pronouns we’ll
be using. It’s based on Dynamic Predicate Logic (DPL), developed by Groenendijk and Stokhof
(1991), and its extension in Groenendijk et al. (1996). The approach is a dynamic one, so
ultimately we’ll be giving meanings in terms of an update function [·] which applies to an input
information state from the context and returns an information state as output.

To define the notion of a state, we first need to introduce assignment functions: an assignment
\(g\) is a partial function from variables to elements of the domain of individuals in the model. From
this we define the notion of a possibility: a possibility \(i\) is a set of world-assignment pairs. And
from this we define an information state: an information state \(s\) is a set of possibilities.

Now we’ll give a partial definition of the update function [·] for a simple interpretation language
based on FOL. There are only two syntactic differences. First, the dynamic versions of the
logical symbols will be marked with a \(\tilde{\cdot}\) above them, to distinguish them from the classical
variants we are using in the metalanguage, and second, \(\tilde{\exists}x\) is a well formed formula on its own.
For our purposes, the important parts of the definition of the update function are the following,
where \(D\) is the domain of the model, \(F\) is a predicate, and \(\phi\) and \(\psi\) are formulas:

\[
\begin{align*}
\text{(10) a. } & s[F(x)] = \{i : i \in s \land w_i \in [F(g_i(x))]\} \\
\text{b. } & s[\phi \land \psi] = s[\phi] \cdot s[\psi] \\
\text{c. } & s[\tilde{\exists}x] = \{i : \exists j \exists d(j \in s \land d \in D \land w_i = w_j \land g_i = g_j^{g \rightarrow d})\}
\end{align*}
\]

An update with an atomic formula tests each input possibility for whether the formula is true at
that possibility and preserves only those possibilities which pass the test. A conjunctive update
is just the sequence of updates with each conjunct. And an existential update adds to the input
possibilities a new possibility for each way an input possibility’s assignment can be extended
to provide the relevant variable with a value.

Now we will introduce an account of counterfactual donkey sentences which is a straightforward
combination of the ordering semantics for counterfactuals and the dynamic binding ac-
count of indefinites and pronouns. Essentially, this is the proposal given in Wang (2009), except
where she moves to a test semantics based on Veltman (2005), we’ll stick more closely to the
traditional idea of a counterfactual being truth conditional (which, in our dynamic framework,
amounts to being eliminative).

8These ideas are closely related to the file-change semantics given in Heim (1982).
9We defined the update function directly, but we could have instead given interpretations of formulas as pairs
of possibilities (input and output), then defined updates derivatively, as in DPL. Furthermore, I do not take the
use of an interpretation language here to be crucial—it is used for convenience. Ultimately I’d prefer to give the
semantics in a directly compositional way.
The basic idea is this: $A \square \rightarrow C$ is true at a possibility iff all the nearest $A$-possibilities verify $C$. To spell this out, we need to say what it is to be a nearest $A$-possibility and what it is to verify $C$. For any formula $A$, $j$ is an $A$-possibility for $i$ (or $j \in /A/i$) iff $\exists k (g_k = g_i \land j \in \{k\}[A])$. So the world of $j$ may be any world where $A$ is true on the relevant variable assignment, but the assignment must be the result of updating $i$’s assignment by $A$. A possibility is a nearest $A$-possibility (to a base possibility $i$) iff it is in the set that results from applying the selection function $f$ to $A$ and $i$, where

$$(11) \quad f(A,i) = \{ j : j \in /A/i \land \neg \exists k (k \in /A/i \land w_k <_{w_i} w_j) \}.$$  

This returns the set which includes a possibility iff it is an $A$-possibility (relative to $i$) whose world is as close to the world of $i$ as the world of any $A$-possibility is. A possibility $i$ verifies a formula $C$ iff $\{i\}[C] \neq \emptyset$. That is, iff updating a state containing just that possibility with $C$ does not lead to an empty state.

Using $f$ to collect the nearest $A$-possibilities, we can give a simple dynamic ordering semantics for counterfactuals as follows:

$$(12) \quad s[A \square \rightarrow C] = \{ i : i \in s \land \forall j (j \in f(A,i) \supset \{j\}[C] \neq \emptyset) \}$$

This is just the Stalnaker-Lewis idea carried over to the dynamic framework: it rules out input possibilities whose nearest $A$-possibilities do not all verify $C$. Let’s see an example of this proposal in action. We’ll try it on (13), which we’ll assume is the translation of our original counterfactual donkey sentence (4) into our interpretation language.

$$(13) \quad (\exists x \land \text{donkey}(x) \land \text{Balaam-owns}(x)) \square \rightarrow \text{Balaam-beats}(x).$$

Suppose we have an input context $s = \{ (w_0,g), (w_1,g) \}$ and a model $M_1$ with the following features:

<table>
<thead>
<tr>
<th>$s_1$</th>
<th>donkey</th>
<th>Balaam-owns</th>
<th>Balaam-beats</th>
</tr>
</thead>
<tbody>
<tr>
<td>$w_0$</td>
<td>$a,b$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$w_1$</td>
<td>$a,b$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$w_2$</td>
<td>$a,b$</td>
<td>$a,b$</td>
<td>$a,b$</td>
</tr>
<tr>
<td>$w_3$</td>
<td>$a,b$</td>
<td>$a,b$</td>
<td>$a$</td>
</tr>
</tbody>
</table>

So Balaam doesn’t own donkeys in either $w_0$ or $w_1$, but $w_0$ is closer to $w_2$, where he owns and beats two donkeys, than it is to $w_3$, where he owns two but only beats one, whereas $w_1$ is closer to $w_3$ than $w_2$. The semantics of (12) predicts that in $M_1$, $s[(13)] = \{ (w_0,g) \}$. This is what we’d expect. An utterance of (4) should eliminate a possibility with a world like $w_1$, where in the nearest world where Balaam owns some donkeys, he doesn’t beat all of them. And it should keep a world like $w_0$, where Balaam beats all the donkeys he owns in the nearest world where he owns any. So far, so good. But this theory runs into problems. Most—among them how to deal with ‘weak’ readings, modal subordination, and might-counterfactuals—I will have leave aside for now, as we turn to the one that will occupy us for the remainder of the paper.
1.1. The universal entailment problem

The problem I’d like to address is that on the semantics in (12), there is no high reading. It seems, then, not to have a way to predict the kind of entailments in (5).

Take a model, for instance, like the following:

<table>
<thead>
<tr>
<th>$I_2$</th>
<th>donkey</th>
<th>Balaam-owns</th>
<th>Balaam-beats</th>
</tr>
</thead>
<tbody>
<tr>
<td>$w_0$</td>
<td>$a,b,c$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$w_1$</td>
<td>$a,b,c$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$w_2$</td>
<td>$a,b,c$</td>
<td>$a,b$</td>
<td>$a,b$</td>
</tr>
<tr>
<td>$w_3$</td>
<td>$a,b,c$</td>
<td>$a,b,c$</td>
<td>$a$</td>
</tr>
</tbody>
</table>

This is like the model before, except now there’s another donkey which Balaam only owns in $w_3$ and does not beat there. As before, in this model $\langle w_0,g \rangle$ verifies (13). But it does not verify (14), one of the universal entailments we would expect.

(14) \( \text{donkey}(c) \land \text{Balaam-owns}(c) \not\rightarrow \text{Balaam-beats}(c) \)

So it doesn’t verify the universalized (5), either. This semantics, then, does not have high readings. How troubled should we be by this?

The first thing to note is that we don’t always want these universal entailments: some counterfactual donkey sentences seem not to have them except in special contexts, and most counterfactual donkey sentences can be put in contexts where they don’t seem to have these entailments. Suppose, for example, that I could pick any number between 1 and 10, but I could only pick one number. I actually picked 4. And now I say the following:

(15) If I had picked a prime number, I would have picked 2.

Certainly there is no commitment here to the truth of (16).

(16) If I had picked 7, I would have picked 2.

This was noted by van Rooij and is what WR call a ‘low’ reading of counterfactual donkey sentences.\(^\text{10}\) And we might think that $\mathcal{M}_2$ and the semantics of (12) is just what we need to make sense of the following kind of argument, which includes the target counterfactual donkey sentence interpreted in a way that excludes the universal entailments.

(17) Balaam is very poor and $c$ is a very expensive donkey. So if he owned a donkey, he wouldn’t own $c$, but would only own $a$ and $b$, who are cheap. And he would beat both $a$ and $b$ if he owned them. So if Balaam owned a donkey, he would beat it. That he wouldn’t beat $c$ if he owned it is irrelevant.

\(^\text{10}\)Their accounts treat low readings in the same way as weak readings, through selective binding.
It is data like these which motivate Wang’s acceptance of a semantics like (12) without high readings. But what are we to say about those cases in which the universal entailments do seem to be present? As we noted at the outset, it’s pretty natural accept them when (4) is uttered without a surrounding argument like the one in (17).

1.2. The special ordering fix and WR’s objection

Wang herself says nothing about how to derive these entailments. WR, however, suggest a way for an account like Wang’s (and that given in (12)) to predict them in certain contexts. They observe (p. 296) that if for all the individuals in the domain, the nearest world where one individual satisfies the antecedent is no nearer than the nearest world where any other individual satisfies the antecedent, then the counterfactual donkey sentence will have the relevant universal implications. A bit more generally and formally—and this is my formulation—we get the universal entailments in contexts with a special similarity ordering set where

\[ (18) \quad \text{A model } \mathcal{M} \text{’s ordering set } \mathcal{S} \text{ is special relative to an input state } s \text{ iff } \forall i(i \in s \supset \forall j(j \in /A/i \supset \exists k(k \in f(A,i) \land g_j = g_k))). \]

That is, for all possibilities \( i \) in \( s \), if \( j \) is an \( A \)-possibility for \( i \), then among the nearest (relative to \( i \)) \( A \)-possibilities is a possibility which shares an assignment with \( j \).

For example, in a model with the interpretation \( I_2 \) and input state as before, what would the ordering set have to look like in order for it to be special? The ordering for \( w_0 \) in \( S_3 \) is \( w_0 <_{w_0} w_2 <_{w_0} w_3 <_{w_0} w_1 \). This prevents \( S_2 \) from being special, since \( \langle w_0, g \rangle \) is in \( s \) and there is a possibility in \( /A/(w_0,g) \), namely \( \langle w_3, g^{x \rightarrow c} \rangle \), that does not share an assignment with any possibility in \( f(A,\langle w_0, g \rangle) \), which only includes \( \langle w_2, g^{x \rightarrow a} \rangle \) and \( \langle w_2, g^{x \rightarrow b} \rangle \). To make the ordering special, we need to adjust the ordering of worlds so that \( f(A,\langle w_0, g \rangle) \) also includes a possibility whose assignment is \( g^{x \rightarrow c} \). Since \( w_3 \) is the only world where \( c \) is a donkey owned by Balaam, we can only do this by making \( w_3 \leq_{w_0} w_2 \). For illustration, let’s let the new ordering for \( S_4 \) be \( w_0 <_{w_0} w_2 =_{w_0} w_3 <_{w_0} w_1 \). We can keep \( <_{w_1} \) as before.

Now that we have a special ordering, let’s see how it generates the universal entailments. The trouble we ran into before is that \( \langle w_0, g \rangle \) verified (13) but not (14), repeated here as (19a) and (19b), respectively.

\[ (19) \begin{align*}
\text{a.} & \quad (\exists x \exists! \text{donkey}(x) \langle x, A \rangle \text{Balaam-owns}(x)) \quad \square \rightarrow \text{Balaam-beats}(x). \\
\text{b.} & \quad \text{donkey}(c) \langle c, A \rangle \text{Balaam-owns}(c) \quad \square \rightarrow \text{Balaam-beats}(c)
\end{align*} \]

But now with \( f(A,\langle w_0, g \rangle) \) including \( \langle w_3, g^{x \rightarrow c} \rangle \), it will no longer be that \( \langle w_0, g \rangle \) verifies (19a), since \( \{\langle w_3, g^{x \rightarrow c} \rangle\} \) doesn’t verify \( C \). And to get an interpretation on which it does verify (19a), Balaam would have to beat \( c \) in \( w_3 \).

To keep the semantics as is, we need to have a special ordering to get the universal entailments. What the simple ordering semantics + dynamic binding theory predicts, then, is that the uni-
versal entailments only arise in contexts where the similarity ordering is special. WR, however, claim to empirically falsify this prediction, and reject Wang’s account on these grounds. They claim that there are contexts on which the entailments arise but on which the similarity ordering is not special. I will illustrate their point with my own case, but it’s in the same spirit as the one they offer.

(20) SCENARIO: Balaam took part in a game show which had the following format: if you win the easy first round, you win Herbert, an obnoxious and disobedient donkey. The reward for the much more difficult second and third rounds are the well-mannered and obedient donkeys Eeyore and Platero, respectively. Losing a round of the game eliminates the player, keeping them from advancing to any later rounds. Balaam was eliminated in the first round, and so remains donkeyless.

John, only aware of the game’s first round, asserts our original counterfactual donkey sentence (4), repeated here as (21), since he knows about Balaam’s short temper.

(21) If Balaam owned a donkey, he would beat it.

Sarah, who has more information about the game, corrects him with (22).

(22) No, Balaam could have won Platero or Eeyore too, and he wouldn’t beat either of them if he owned them.

It is implausible, WR would contend, to claim that in this context a world where Balaam advances to and wins the third round is just as similar to the actual world as the one where he wins just the first round. But this is what we would have to say to give John’s utterance a false reading which (22) can be used to disagree with.

<table>
<thead>
<tr>
<th>$s_3$</th>
<th>donkey</th>
<th>Balaam-owns</th>
<th>Balaam-beats</th>
</tr>
</thead>
<tbody>
<tr>
<td>$w_0$</td>
<td>$h,e,p$</td>
<td>$h$</td>
<td>$h$</td>
</tr>
<tr>
<td>$w_1$</td>
<td>$h,e,p$</td>
<td>$h$</td>
<td>$h$</td>
</tr>
<tr>
<td>$w_2$</td>
<td>$h,e,p$</td>
<td>$h,e$</td>
<td>$h$</td>
</tr>
<tr>
<td>$w_3$</td>
<td>$h,e,p$</td>
<td>$h,e,p$</td>
<td>$h$</td>
</tr>
</tbody>
</table>

$S_3$-Intuitive: $w_0 < w_0 \ w_1 < w_0 \ w_2 < w_0 \ w_3$

$S_3$-Special: $w_0 < w_1 \ w_1 = w_1 \ w_2 = w_1 \ w_3$

To get the needed universal entailments, we need $S_3$-Special, but it’s hard to see how the ordering could be like that, rather than like the non-special $S_3$-Intuitive.

1.3. A semantics with high readings

WR conclude that van Rooij was right: we need to give a semantics of counterfactual donkey sentences which has a reading—the high reading—on which the universal entailments arise no matter what the similarity ordering, no special order needed.
The main innovation in van Rooij’s proposal is to derive similarity orderings over possibilities out of the ones over worlds, and allow possibilities to be comparable only if they share an assignment function. We define an assignment-sensitive similarity ordering \( \leq^* \) based on the old world ordering \( \leq \) as follows.\(^{11}\)

\[ j \leq^* k \text{ iff } w_j \leq_{w_i} w_k \land g_j = g_k \]

Now the only changes we need to the semantics is to have a selection function use this assignment-sensitive ordering rather than the ordering on worlds, and a semantics for \( \Box \rightarrow \) which uses the new selection function.

\[ f^*(A,i) = \{ j : j \in /A/i \land \neg \exists k (k \in /A/i \land k <^*_w j) \} \]
\[ s[A \Box \rightarrow C] = \{ i : i \in s \land \forall j (j \in f^*(A,i) \supset \{ j \} \{ C \neq \emptyset \}) \} \]

What this new assignment-sensitive semantics does is encode the need to check for each assignment the nearest \( A \)-possibility with that assignment whether it verifies \( C \), regardless of whether there are \( A \)-possibilities with different assignments and nearer worlds. This predicts the universal entailments regardless of the similarity ordering on worlds. And in particular, it predicts the universal entailments for (21) in scenario (20) without having to posit the supposedly implausible special ordering. Using \( S_3 \)-Intuitive, the assignment-sensitive selection function \( f^* \) will return \( \{ \langle w_1, g^{x\rightarrow h} \rangle, \langle w_2, g^{x\rightarrow e} \rangle, \langle w_3, g^{i\rightarrow p} \rangle \} \), which has members (namely \( \langle w_2, g^{x\rightarrow e} \rangle \) and \( \langle w_3, g^{i\rightarrow p} \rangle \)) which do not verify \( \text{Balaam-beats}(x) \). So the assignment-sensitive semantics predicts the sentence to be false in this model, as desired. And more generally, a possibility will verify a counterfactual donkey sentence iff it also verifies the universal entailments. Thus WR claim that this kind of case supports assignment-sensitive semantics like (25) over the assignment-insensitive theories like the one given in (12).\(^{12}\)

2. Why we don’t need the high reading

I find WR’s argument for the assignment-sensitive semantics unpersuasive. As mentioned in \S\ 1, we can’t always assume that the similarity ordering in the semantics of counterfactuals matches an intuitive notion of similarity. So we can’t just appeal to our intuitive idea of similarity, as WR do, to rule out the special ordering in scenario (20). Later in this section I will sketch what we need to say about the similarity relation to get the special ordering in the relevant scenarios, and defend this as a tenable view. But first I will argue that even if we move to the assignment-sensitive semantics with high readings, we still need to appeal to an ordering of the special kind in scenarios just like (20) in order to correctly predict the presence of strong entailments.

The takeaway is that within the ordering semantics + dynamic binding framework, the move to assignment-sensitivity doesn’t save us from having to appeal to a special ordering in scenarios

\(^{11}\)In van Rooij’s original formulation and WR’s follow-up, there’s an additional condition on the similarity orderings for possibilities: for \( \leq^*_j \) to hold between \( j \) and \( k \), it must be that \( g_j = g_k \supset g_i \). As far as I can tell, though, this doesn’t play any helpful role.

\(^{12}\)It is only after they make this argument that they move, for independent reasons (based on NPI data), to a dynamic strict theory. As they present the argument discussed in this section, it is an argument in favor of van Rooij’s account (more or less that of (25)) over Wang’s.
like (20) anyways, so, at least in debates between those who share this framework, the proponent of assignment-insensitive semantics may avail herself of this ordering to generate the universal entailments we’ve been discussing.\textsuperscript{13}

To make this point, we need to make a distinction between two kinds of universal entailments a counterfactual donkey sentence might have. The universal entailments we’ve been discussing so far, the \emph{high} entailments, are like those we’d expect from universal quantification scoping over the whole conditional—everything is such that if it were a donkey Balaam owned, he would beat it. This is as opposed to \emph{low} entailments, which can be true so long as the conditional is true of the thing that would satisfy the antecedent, were it to hold. The other kind of universal entailments are \emph{strong} entailments, which are like those we’d expect from universal quantification in the consequent—if Balaam owned a donkey, he would beat every donkey he owned. This is as opposed to \emph{weak} entailments, which do not require this. We can summarize these entailments with (partial) paraphrases:

\[
\begin{array}{cc}
\text{High} & \text{Low} \\
\forall x((A(x) \square \rightarrow C(x)) & (\exists x A(x)) \square \rightarrow C(x)) \\
\text{Strong} & \text{Weak} \\
\ldots \square \rightarrow \forall x (A(x) \supset C(x)) & \ldots \square \rightarrow \exists x (A(x) \land C(x))
\end{array}
\]

Once we’ve made these distinctions, we can see first, that strong and weak can each be combined with high and low, and second, that these combinations are not equivalent with the simple high and low entailments as stated above.

\[
\begin{array}{cc}
\text{High} & \text{Low} \\
\text{Strong} & \forall x((A(x) \square \rightarrow \forall y (A(y) \supset C(y)))) & (\exists x A(x)) \square \rightarrow \forall y (A(y) \supset C(y))) \\
\text{Weak} & \forall x((A(x) \square \rightarrow \exists y (A(y) \land C(y)))) & (\exists x A(x)) \square \rightarrow \exists y (A(y) \land C(y)))
\end{array}
\]

What is important for us are the contrasts between high/weak, high/strong, and simple high entailments. The contrast between high/weak and the others is easy enough to see; note that in the problem case from §1.2, $M_3$ with $S_3$-Intuitive, the high/weak entailments for (4) in fact hold, though the high and high/strong ones don’t. The high/strong vs. high contrast is less obvious, but in the next section we’ll see an example that makes it clear that they can differ.

The problem for the assignment-insensitive semantics was supposed to be that it failed to predict high entailments given an intuitive similarity ordering, and the proposed solutions were special orderings on the one hand and moving to assignment-sensitivity on the other. But while assignment-sensitivity does, on its own, get us simple high entailments, it doesn’t get us high/strong entailments. It turns out that to get high/strong entailments, the assignment-sensitive semantics also needs to use special orderings. But the special orderings can get us the high/strong entailments without assignment-sensitivity. So if we want high/strong entailments,

\textsuperscript{13} Actually, this is a bit stronger conclusion than is warranted. Perhaps there are other semantic theories which still make use of this framework, but work out the details in a different way. And perhaps there could be some reasonably non-ad hoc such theory that is assignment-sensitive and gets both high and strong readings.
rather than just high entailments, it seems that we’re going to need to appeal to special orderings. Let’s illustrate this point with a case for which we need high/strong, and not merely high, entailments.

(26) **Scenario:** Cory, who is donkeyless, is a bit crazy. He’s disposed to take out his anger on his most prized possession. He also took part in the game show described in (20), but also lost in the first round. Had he won any rounds, the prize from the most advanced round he won would have become his prized possession, and he would have beaten it, but he wouldn’t beat anything else.

Now consider the following:

(27) If Cory owned a donkey, he would beat it.

In this scenario, the salient reading of (27) seems false. And it seems false because the relevant high/strong entailments don’t hold. If Cory had owned Eeyore, for example, it wouldn’t be true that he would beat every donkey he owned. But note that all of the high entailments do hold. If Cory owned Herbert, he would beat Herbert; if he owned Eeyore, he would beat Eeyore; and if he owned Platero, he would beat Platero. So, first point from this example: high/strong $\neq$ high.

The structure of this scenario is very similar to that of scenario (20). Again we can consider models with the intuitive ordering and a corresponding special ordering

<table>
<thead>
<tr>
<th>$I_4$</th>
<th>donkey</th>
<th>Cory-owns</th>
<th>Cory-beats</th>
</tr>
</thead>
<tbody>
<tr>
<td>$w_0$</td>
<td>$h,e,p$</td>
<td></td>
<td></td>
</tr>
<tr>
<td>$w_1$</td>
<td>$h,e,p$</td>
<td>$h$</td>
<td>$h$</td>
</tr>
<tr>
<td>$w_2$</td>
<td>$h,e,p$</td>
<td>$h,e$</td>
<td>$e$</td>
</tr>
<tr>
<td>$w_3$</td>
<td>$h,e,p$</td>
<td>$h,e,p$</td>
<td>$p$</td>
</tr>
</tbody>
</table>

Second point from this example: to get the desired high/strong entailments, both the assignment-insensitive semantics in (12) and the revised, assignment-sensitive semantics from (25) need to use a special ordering, such as $S_4$-Special. Using $S_4$-Intuitive, the assignment insensitive $f$ will return $\{\langle w_1, g^{x\rightarrow h}\rangle\}$, and the assignment-sensitive $f^*$ will return $\{\langle w_1, g^{x\rightarrow h}\rangle, \langle w_2, g^{x\rightarrow e}\rangle, \langle w_3, g^{x\rightarrow p}\rangle\}$. In either case, all of the selected possibilities verify Cory-beats(x), yielding the prediction that the counterfactual is true on either semantics. So no high/strong entailments either way.

But when we move to $S_4$-Special, both selection functions will return $\{\langle w,h\rangle : w \in \{w_1, w_2, w_3\} \land h \in \{g^{x\rightarrow h}, g^{x\rightarrow e}, g^{x\rightarrow p}\}\}$, predicting a false reading given $I_4$, and more generally a false reading unless the strong/high entailments also hold.

Just as with the case in §1.2, the special ordering is what we need to get the right prediction for the assignment-insensitive semantics, despite the special ordering not matching the intuitive one for the scenario. But now this is also what we need to make the right prediction for the assignment-sensitive semantics as well. The move to assignment-sensitivity, then, doesn’t keep
us from needing to appeal to special orderings in these sorts of scenarios. This undermines WR’s argument for assignment-sensitivity on the grounds that it does avoid such appeals.

2.1. Why the special ordering?

Perhaps, though, what we should conclude from this not that WR’s argument doesn’t refute the assignment-insensitive semantics, but that it also refutes the assignment-sensitive semantics, and that a more radical revision is required. We should require a high/strong reading, one that predicts these entailments even without a special ordering.

In this section I want to briefly defend the view that we need not make such a move—that using the special ordering even in the scenario is not particularly implausible. I do so by outlining a proposal about the similarity relation which will predict special orderings in the relevant contexts. This will not yet give us an argument against accounts which get the entailments through a high/strong reading instead of through the special ordering; that argument will come in §3.

What makes one world closer than another to an evaluation world? As discussed in §1, the answer can’t simply be that considering all the facts in these worlds, it is more intuitively similar than the other is. For the same reason, it can’t be that it has some greater amount (by some measure) of overlap in facts, where all facts count the same. Facts of some kinds count more heavily in determining (dis)similarity than others.

However, proposals like Lewis’s (as well as others in the same spirit) to weigh differences in certain kinds of fact more heavily than others won’t predict the special ordering in all the cases we would need special orderings for. We may assume that it takes more widespread miracles and less perfect match of particular facts with the evaluation world for Balaam or Cory to win two or three rounds of the game than it would for them to win just one. We should say, then, what an account of the similarity relation would have to look like to get the special orderings when we need them.

Here is my suggested amendment: we start with some standard account, such as Lewis’s, for determining similarity. Then we allow the similarity orderings to be affected by the antecedent of an asserted counterfactual. In particular, we say that for each of the salient ways the antecedent might be made true, how it is made true in a given world is irrelevant to determining similarity. When determining similarity between two worlds, we look for violations of law, amount of mismatch in particular fact, and so on, except in the parts of the world that are involved in making the antecedent true.

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14 I suspect WR would be sympathetic to this extension of their argument, since their independently motivated move to a dynamic strict account avoids the problem with high/strong entailments. Their account predicts these, rather than the merely high entailments that they claim it does.

15 Regarding ‘making true’, I have in mind something along the lines of Fine’s notion of exact truthmaking (see Fine (2017)). ‘Salient’ is, as it often is, left vague and underdeveloped. Investigating what account of salience gets us the best results for this proposal would be a worthwhile undertaking, but not one I can pursue here.
This will typically result in special orderings for counterfactuals with indefinites in the antecedent. If the reason that the world where Cory owns Eeyore and Platero as well as Herbert was farther from the evaluation world than the one where he owns just Herbert is that it takes more widespread miracles for him to own all three than it does to just own Herbert, then these worlds will be brought to the same degree of similarity by my proposal, since it tells us to ignore the differences involved in the salient ways of making it true that Cory owns a donkey, and his owning the three donkeys is one salient way of owning a donkey and his owning just Herbert is another.

We need not take this proposal to be entirely ad hoc, since it extends beyond counterfactuals with indefinites in the antecedent to any counterfactual with an antecedent that has more than one salient alternative way which might make it true. This gives us nice results both for counterfactuals with disjunctive antecedents as well as other unspecific antecedents.

Since asserting counterfactuals with disjunctive antecedents presumably makes salient the possibility of either disjunct making the antecedent true, our proposal tells us that which disjunct is true (and what goes into making it true) is irrelevant to similarity, regardless of differences in amount of miracles required to make each true. Thus, we’d expect the conjunctive implications from counterfactuals with disjunctive antecedents in the cases that motivate acceptance of simplification of disjunctive antecedents. For instance, we would expect to be able to infer (28b) from (28a) in the example from Nute (1975), since according to my proposal there should be worlds where the sun grows cold that are just as similar to the actual world as any world where we have good weather.

(28)  
\[ \text{a. If we were to have good weather this summer or if the sun were to grow cold before the end of the summer, we would have a bumper crop.} \]
\[ \text{b. If the sun were to grow cold before the end of the summer, we would have a bumper crop.} \]

For a case without disjunction or an indefinite, but with multiple salient ways of making the antecedent true, consider this example from Bennett (2003: 219–220), who attributes the idea to John Pollock as reported by Nute (1980: 104).

(29)  
\[ \text{SCENARIO: My coat was not stolen from the restaurant where I left it. There were two chances for theft—two times when relevant indeterminacies or small miracles could have done the trick. They would have involved different potential thieves; and the candidate for the later theft is a rogue who always sells his stuff to a pawnbroker named Fence.} \]

(30)  
\[ \text{If my coat had been stolen from the restaurant, it would now be in Fence’s shop.} \]

Our first reaction is that in this scenario this counterfactual is false, or at least unassertable, since it might have been stolen by the earlier thief. But a straightforward application of a proposal like Lewis’s predicts that it would be true, since the later theft would involve a larger region of perfect match of particular fact. With my proposal, though, we ignore this difference in fact-matching, since they’re involved in salient ways of making the antecedent true. This
means that there will be among the closet worlds worlds where the earlier thief steals my coat and worlds where the later thief steals it. We thus predict (30) to be false. We get a similar desirable result if we modify the example to let one of the salient possible thefts involve a bigger miracle, rather than just an earlier one. And having seen this pattern, examples can be easily multiplied.

These seem like attractive results. However, the proposal won’t work for all cases. As is well known from work on disjunctive antecedents, and as we noted in §1, there are exceptions to these patterns. In some contexts, apparently it does matter how the antecedent is made true.

(31) a. If Spain had joined the Allies or the Axis, they would have joined the Axis.
    b. If Spain had joined a side, it would have been the Axis.

I assume that in these cases the alternative of joining the Allied side will be salient in whatever sense of salience we need for the special ordering. But for them to be true, as they plausibly are, we can’t have worlds where Spain joins the Allies rather than the Axis as among the closest worlds where the antecedents are true.

In addition, even for sentences which have high entailments by default, we can construct contexts in which these entailments do not arise.

(32) If Balaam had won any rounds, he would have won just the first one. So if he had owned a donkey, he would have only owned Herbert. And if he had owned Herbert, he would have beat him. So if he owned a donkey, he would beat it.

In this context, the sentence seems true, even though the high entailments still fail to hold. So not only do we need an account that is sometimes indifferent to antecedent truthmaker, we also need one that is sometimes not indifferent. How similarity is determined, then, depends on whether the utterance is in an antecedent-truthmaker-relevant or -irrelevant context. Ultimately we’ll want an account of what makes a context one way or the other, and what unified account of similarity, if any, underlies them. But for now we’ll just accept that there are these two types of orderings, and one type—the antecedent-truthmaker-irrelevant—typically leads to special orderings for counterfactual donkey sentences.

16 Alternatively, we might try to capture these differences as differences in ‘salience’ of alternatives, a suggestion made to me by Kyle Blumberg. As much of a black box as it currently is, we might be able to construe ‘salience’ in a way that allows for this. However, it won’t be easy, since to get the identificatory disjunctive antecedent cases right, we’d have to say that these antecedents don’t make both disjuncts salient.

17 This bifurcated account is somewhat like the orderings that would be required to make sense of backtracking as well as non-backtracking counterfactuals.

(i) a. If he jumped, he would have died.
    b. He wouldn’t have jumped unless there was a net. So if he had jumped there’d be a net there to save him and he wouldn’t have died.

Indeed, it’s not so far-fetched to think that non-backtracking and antecedent alternative indifference on the one hand, and backtracking and antecedent alternative sensitivity on the other are instances of the same phenomenon. Perhaps backtracking counterfactuals are those which the truthmaker of the antecedent is relevant to similarity, on a construal of truthmaker which includes causal origins.
This is only a sketch of an account, but it seems to me not an obvious dead-end. For WR’s argument to succeed, we would need to show that nothing along these lines of determining similarity could work, since we would need to rule out special orderings in the relevant cases. So until that’s done, we should take the assignment-insensitive semantics with special orderings to be a viable account of counterfactual donkey sentences with high entailments.

Before proceeding to the final section, I wish to point out one consequence of the current special ordering-based account. If, as I think we should, we still require the similarity relation to be strongly centered, even in the antecedent-truthmaker-irrelevant contexts, we will not always be able to produce a special ordering, and so won’t be able to generate high entailments. This is because in some cases, the antecedent will be true in the evaluation world. Since the evaluation world will be strictly closer to itself than any other world is, worlds with different ways of making the antecedent true will not be as close, preventing a special ordering. In these cases, on the assignment-insensitive ordering semantics, we shouldn’t expect high entailments. This prediction differs from that of accounts which would allow for high (or high/strong) readings. On such views, we should expect there to be high entailments in some of these cases, since the high entailments are not dependent in any way on the similarity ordering of worlds.

I will argue that on this point, the assignment-insensitive ordering semantics make the correct predictions and accounts with high (or high/strong) readings make incorrect ones. There are no high entailments when the antecedent is true.

3. Why we don’t want the high reading

Before looking at a case where the predictions of the different accounts come apart, I’d like to make an observation about what is involved in high entailments. We’ve been putting them in terms of a universal quantifier, ranging over a domain given in the model, implicitly assumed to be restricted by the context. But we’ve glossed over what exactly this amounts to by only looking at cases where what exists does not vary from world to world. Once we start to look at scenarios where this assumption is dropped, we need to ask whether the outermost $\forall$ used to state what the high entailments are is meant to range over just those things that exist in the world of evaluation, or rather whether it includes merely possible entities as well. In other words, we need to ask whether this is an actualist or possibilist quantifier.

I think it’s clear enough how this question is to be answered. Suppose Allie and Bert think Mary the potter probably didn’t make anything yesterday. And now Allie says the following:

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18 Why don’t we give up strong centering for these cases? After all, if the only difference between the evaluation world and some other one is how the antecedent is made true, we might expect them to be equally similar to the evaluation world. This is worth considering, but the data in the next section suggest we should not do so.

19 Most likely it’s a bad idea to put this contextual restriction in the models themselves, rather than, say, putting domain variables in the syntax. See Stanley and Szabó (2000). Incidentally, we might want our similarity orderings not to be just given in the models either, but at least partly determined through something syntactically present. One proposal for how to do this is made in Arregui (2009).

20 And in particular where the extension of the restrictor of the antecedent’s indefinite (in the cases we’ve looked at: what is a donkey) doesn’t vary from world to world.
(33) If Mary had made a vase, she would have made it from glass.

Now consider:

Case 1: Mary didn’t make any vases, and there is no contextually relevant actual pottery.

In this case, (33) does not come out trivially true or give rise to presupposition failure. Nor does it depend on looking at various non-pottery that exists in the world (the high entailment need not imply, for example, that if Mary were a vase that she made, she would have made herself from glass). Instead, what goes into determining the truth or falsity of (33) in Case 1 are some merely possible vases and their composition in worlds where Mary made them—the quantifier in question is a possibilist one. So if there are high readings of counterfactual donkey sentences, they require that all relevant possible entities are such that, in the closest worlds where they satisfy the antecedent, they satisfy the consequent.

With this in mind, let’s return to the different predictions made by the special ordering and the high reading accounts of high entailments. If there are high readings, we should expect high entailments even when the antecedent is true in the evaluation world, and we’ve now seen that this requirement extends to merely possible entities. If high entailments come from a special similarity ordering, we shouldn’t expect them to arise when the antecedent is true in the evaluation world, since in such cases there can be no special ordering without violation of strong centering.

Let’s look a case, then, where some contextually relevant actual entity satisfies the antecedent and consequent but a merely possible one doesn’t satisfy the consequent in the nearest world where it satisfies the antecedent. Suppose the conversation between Allie and Bert continues:

(34) a. Bert: No, she could have made it from clay!
   b. Allie: Oh, I didn’t know she had any clay left, nevermind what I just said, then.

So here Bert raises a relevant possible way for the antecedent to be made true that wouldn’t lead to the truth of the consequent, which gets Allie to retract her claim. This is just what we’d expect on a high reading. But now suppose that it turns out that Mary in fact did make some vases yesterday.21

Case 2: Mary made two vases, both of glass.

In this case it seems that Allie’s utterance of (33) was true, if only by luck. And the fact that Mary could have made a different vase and she would not have made that one from glass has no

21 One might worry that this would make the original assertion infelicitous or at least difficult to evaluate, since counterfactuals generally presuppose the falsehood of their antecedent. But there are well known exceptions to this generalization, such as the famous case from Anderson (1951): “If Jones had taken arsenic, he would have shown just exactly those symptoms which he does in fact show.” That Allie and Bert are unaware at the time of utterance that the antecedent is true, but are also not certain that it’s false, should make it clear enough that nothing too strange is going on here.
bearing on its truth. Once the facts about what Mary actually made are known to Allie and Bert, challenging the original assertion again by raising the possibility of the clay vase is bizarre.

(35)  a.  *Allie*: Looks like I was right after all.
    b.  *Bert*: ??No, even though she *didn’t* make any clay vase, she still *could* have made a vase from clay, and she wouldn’t have made *that* from glass.

So it seems that in this case, any available reading of (33) is true, regardless of the possibility Bert raises. The high entailments seem not to arise in this case. This is just as the special ordering (with strong centering) account predicts. And it’s not predicted by accounts which allow high readings. Where there are high entailments, I conclude, we should take them to be due to a special ordering rather than being baked in semantically, through a high reading.

There are a couple objections we should address. First, the proponents of high readings—van Rooij and WR—allow that in some contexts there are low (or for them, low/weak) readings. Why not think this is what’s happening here? Two reasons. First, because their method for obtaining low readings guarantees weak readings. But the salient reading of (33) is not weak. Consider:

*Case 3*: Mary made one vase of glass and one of clay.

Here we would take (33) to be false, even though it would be true in Case 2. But on a weak reading, it would also be true in Case 3.

Second, this utterance seems like it has high entailments in the evaluation worlds where the antecedent is not true (like in Case 1). This is why Allie retracts her assertion once the possible clay vase is brought to her attention—for all she knows, she and Bert are in a world where Mary made no vases, and in such a world her assertion, if it had high entailments, would be false. It’s difficult to see how an account with high readings would treat this utterance as having a high reading in Case 1, but a low reading in Case 2.

The other objection is that the merely possible clay vase gets ignored due to quantifier domain restriction. To evaluate this properly, it would be important to spell out what the account of domain restriction would have to look like to get this right. But there is some reason ahead of time to doubt that it would work, given our judgments of the other cases. A possible clay vase needs to be in the domain to make Bert’s original interjection true, and it seems that it is deemed relevant by both Bert and Allie to Allie’s claim. So we would need to have an account which does not exclude this possible vase through quantifier domain restriction when it should be included—Case 1, for example—and exclude it when there happens to be actual vases that Mary made. I don’t know how this could be done in a way that’s not implausibly ad hoc.

It could be that either of these or some other objection could be worked out together with an account with high (or better, high/strong) readings that treats the above cases successfully. But given the difficulties that would seem to involve, and the fact that the data in this section is just what the special ordering account predicts, I tentatively conclude that counterfactual
donkey sentences do not get high readings, but instead get their occasional high entailments from special orderings.

References


Focus on what’s not at issue: Gestures, presuppositions, appositives under contrastive focus

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Abstract. This paper is an attempt to systematically investigate how contrastive focus interacts with various types of not-at-issue content (co-speech and post-speech gestures, lexical presuppositions, and appositives). I look, in particular, at when focus forces at-issue interpretations of typically not-at-issue content, when it does not, and when such at-issue interpretations are impossible even to satisfy focus-related requirements. I conclude that the main factors affecting how a given type of content aligns along these dimensions are its prosodic (in)dependence and level of attachment in the syntax. The two factors also interact in a non-trivial way, in particular for gestures, which I use as a basis for an analysis of gestures that does not assume that their temporal alignment directly determines their semantics (contra Ebert and Ebert, 2014; Ebert, 2017; Schlenker, 2018), but instead relies on syntax/semantics and syntax/prosody interaction.

Keywords: focus, not-at-issue content, gestures, presuppositions, appositives.

1. Introduction

Contrastive focus has been observed to affect presupposition projection (Abusch, 2002; Simons et al., 2017, a.o.). For example, (1) typically gives rise to a global inference, triggered by stop, that Umbridge used to drink firewhisky, but (2) does not give rise to any global inferences about her previous drinking habits, despite the presence of the presupposition triggers stop and start.

(1) Umbridge might have stopped drinking firewhisky.
   → Umbridge used to drink firewhisky.

(2) Context: The faculty at Hogwarts have to report to Madam Pomfrey whenever they significantly change their drinking habits. Ron knows that Umbridge has filed such a report, but he doesn’t know how exactly her habits have changed; he says:
   Umbridge might have stopped drinking firewhisky, but she also might have started doing so.
   ↗ Umbridge used {to drink, to not drink} firewhisky.

Standard theories of presupposition projection (e.g., Heim, 1983; Schlenker, 2009) can handle examples like (2) by resorting to local accommodation, which is a process of making a presupposition part of the at-issue content by treating it as a conjunct at the level at which it is triggered. For example, applying local accommodation in (2) makes it roughly equivalent to:

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(3) Umbridge might have used to drink firewhisky and stopped, but she also might have used to not drink firewhisky and started.

A similar observation can be made for inferences triggered by co-speech gestures, i.e., content-bearing, non-conventionalized gestural adjuncts co-occurring with verbal expressions they adjoin to. Such inferences typically project from embedded environments (Ebert and Ebert, 2014; Ebert, 2017; Schlenker, 2018; see also Tieu et al., 2017a, b for some experimental evidence):

(4) Context: The Yule ball at Hogwarts is tomorrow.

If Hagrid brings a dog_{\text{LARGE}}, it’s gonna be a mess.

→ If Hagrid brings a dog, it will be a large one.\(^2\)

The status of the inference in (4) is a matter of debate. Ebert (and Ebert) (2014; 2017) claim it is a Pottsian (2005) supplement, and Schlenker (2018) argues it is a special kind of presupposition. The two analyses make very similar predictions for (4). However, contrastive focus can sometimes force co-speech gestures to be interpreted as at-issue restrictive modifiers:\(^3\)

(5) If Hagrid brings a dog_{\text{SMALL}}, it’s gonna be OK,

but if he brings a dog_{\text{LARGE}}, it’s gonna be a mess.

\(\nrightarrow\) If Hagrid brings a dog, it will be a \{small, large\} one.

\(\approx\) If Hagrid brings a small dog... but if he brings a large dog...

At first glance, the parallel between (2) and (5) could be used as an argument in favor of the presuppositional analysis of co-speech gestures, but the empirical picture turns out to be more complicated. This paper is an attempt (to my knowledge, the first one) to systematically investigate the interaction of contrastive focus with different types of not-at-issue content and explain the observed differences in a principled way. I look at when focus-related considerations force at-issue interpretations of typically not-at-issue content and when they do not. I also show that, in some cases, at-issue interpretations are unavailable even when that would be the only way

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\(^2\)For those unfamiliar with “Harry Potter” lore, Hagrid is a half-giant with a fondness for large animals, so this inference is quite natural.

\(^3\)The first discussion of examples like (i) I am aware of is due to Rob Pasternak (p.c.), but such examples can be in principle analyzed by metalinguistic negation, which targets the form and not the content. In this paper I try to look at examples that are unlikely to involve metalinguistic uses of expressions containing projective content.
to make contrast felicitous. The data suggest that two major factors affecting the focus-related behavior of a given type of not-at-issue content are whether it is prosodically independent and where it attaches in the syntax. With this in mind, I sketch an analysis of gestures that relies on both those factors, thus diverging from both Ebert’s and Schlenker’s accounts.

The rest of the paper is organized as follows. In Section 2 I clarify my notation, terminology, and data elicitation practice. In Section 3 I explore when contrastive focus forces at-issue interpretations of typically not-at-issue content, when it does not, and when even contrast requirements cannot force such interpretations. In Section 4 I discuss the issues those data pose for Ebert’s and Schlenker’s analyses of gestures and propose an alternative. Section 5 concludes.

2. Notation, terminology, and data elicitation

I adopt the following notational conventions in this paper:

- In ‘verbal expression GESTURE’, the gesture co-occurs with the verbal expression (the underlining loosely indicates temporal alignment of the gesture, without any syntactic claims).
- In ‘verbal expression — GESTURE’ the gesture follows the verbal expression.
- New gestures are illustrated by pictures.
- A word written in bold indicates prosodic (contrastive) focus marking: primarily (L+)H* pitch accent in ToBI terms (Beckman and Ayers, 1997) on the stressed syllable of the bolded word for verbal content, and kinetic emphasis for standalone gestures.
- A word written in italics in examples indicates prosodic contrastive topic marking: (L+)H* or L*+H pitch accent on the stressed syllable of the italicized word. Note that it is very hard, if not impossible, to distinguish between contrastive topic and contrastive focus prosodic marking in isolation. The choice of marking is thus informed by the semantic considerations.
- [...]F marks semantic focus whenever it is relevant.
- (IP…) marks intonational phrases (IPs) in ToBI terms whenever it is relevant.

Throughout the paper I will use the term not-at-issue to talk about content that projects from embedded environments all the way to the global context, such as the presupposition in (1) or the gestural inference in (4). I will use the term at-issue to talk about content that does not project at all, i.e., is interpreted under the lowest operator under which it is embedded, as in (2) or (5). Thus, for the purposes of this paper I do not care, in particular, whether a given piece of content can be directly negated in the discourse. For example, it has been shown in Syrett and Koev, 2014 that utterance-final appositive relative clauses (ARCs), as in (6) (adopted from Syrett and Koev, 2014; crucially, the original example does not contain negation), can be relatively easily targeted by direct negation in the discourse. For me the content of the ARC in A’s utterance in (6) is still not-at-issue, since it projects from under negation.

(6) A: The symphony didn’t hire my friend Sophie, who is a classical violinist.
   → Sophie is a classical violinist.
   B: That’s not true! Sophie isn’t a classical violinist.

As for the term local accommodation, while it was originally coined for presuppositions, I will use it to talk about treating any type of typically not-at-issue content as a conjunct at the
local syntactic level. For presuppositions that is the level at which the trigger is merged; for appositives and gestures that would be the level at which they adjoin in the narrow syntax.

Finally, the data reported in this paper are based on introspective judgements of native speakers of English (all linguists); for each example judgements were elicited from at least three speakers (for most examples the number of speakers is more than five). Any variation or uncertainty in judgements is reported.

3. When contrastive forces local accommodation, when it does not, and when it cannot

3.1. Contradictory inferences

We have already seen one case of at-issue interpretations of typically not-at-issue content under contrastive focus in (2) for lexical presuppositions and in (5) for adnominal co-speech gestures; (7) illustrates the same case for adverbial co-speech gestures.

(7) If Hermione stirs her potion\textsuperscript{CLOCKWISE}, it will turn blue,

but if she stirs her potion\textsuperscript{COUNTERCLOCKWISE}, it will turn green.\textsuperscript{4}

\[\neg \text{If Hermione stirs her potion, she’ll do so } \{\text{clockwise, counterclockwise}\}.\]

Such examples can be accounted for without any sophisticated theory of interaction of not-at-issue content with focus. Projecting an inference \(p\) globally means imposing a requirement on the context set that it entail \(p\). In each of the examples above, the two inferences \(p\) and \(q\) that would normally project contradict each other. Since no context set can entail a contradiction, it cannot be the case that both \(p\) and \(q\) project. Technically, locally accommodating only one of the inferences in each case should suffice to avoid the contradiction, but this should be ruled out via further pragmatic reasoning on what the speaker believes to be possible (à la Gazdar’s, 1979 clausal implicatures or any alternative). For example, in (5) and (7), projecting one of the contradictory inferences and accommodating the other would render one of the antecedents false, but it is odd to utter a conditional whose antecedent the speaker believes to be false.

The reasoning above applies regardless of the type of focus involved or what the focus alternatives are. However, when the inferences contributed by the not-at-issue expressions within an utterance are not contradictory, the type of focus and the nature of the alternatives do matter for whether a given content ends up projecting. The next two subsections review such cases.

\textsuperscript{4}I believe, when they are not contrasted with each other, the CLOCKWISE and COUNTERCLOCKWISE gestures do not necessarily give rise to any inferences about the directionality of movement, but in a context when the directionality is the only locus of contrast, it naturally has to be interpreted maximally iconically.
3.2. Contrastive topic + focus configuration

Oftentimes the content semantically in focus has to address the question under discussion (QUD; in the sense of Roberts, 2012, a.o.) and thus is inevitably at-issue, as opposed to back-grounded. This is the case, in particular, within a contrastive topic + focus (CT+F) configuration (in the sense of BüRING, 2003, a.o.). Consider, for instance, the following pair of examples:

(8) a. *Hermione petted* Buckbeak, and *Luna petted* Fang.\(^5\)
   QUD: Who petted whom?
   sub-QUDs: Who did Hermione pet? Who did Luna pet?

b. *Hermione petted* Buckbeak, and *Luna fed* Buckbeak.
   QUD: Who did what to Buckbeak?
   sub-QUDs: What did Hermione do to Buckbeak? What did Luna do to Buckbeak?

In (8a), the part of content that specifies that it was Buckbeak who Hermione petted is new information addressing the immediate sub-QUD and thus cannot possibly be presupposed; that Hermione petted someone might very well be (perhaps weakly) presupposed (the same is true, mutatis mutandis, about Fang and Luna). In (8b), what is at-issue is what the girls did to Buckbeak; that they did something to Buckbeak might, once again, be presupposed.

Now, let us turn to perhaps less obvious CT+F examples with co-speech gestures:

(9)  *Context (applies to all animal fighting examples): At Hogwarts, when a small animal and a large animal find themselves in the same room, they usually fight.*
   If *Flitwick* brings a **dog**\(^{[\text{small}]}\)_F, and *Hagrid* brings a **dog**\(^{[\text{large}]}\)_F, they’ll fight.\(^6\)
   \(\not\rightarrow\) If \{Flitwick, Hagrid\} brings a dog, it will be a \{small, large\} one.
   \(\approx\) If *Flitwick* brings a **small** dog, and *Hagrid* brings a **large** dog...

(10) If *Hermione stirs* her potion\(^{[\text{clockwise}]}\)_F, and *Luna stirs* her potion\(^{[\text{counterclockwise}]}\)_F, there will be an explosion.
    \(\not\rightarrow\) If \{Hermione, Luna\} stirs her potion, she’ll do so \{clockwise, counterclockwise\}.
    \(\approx\) If *Hermione* stirs her potion **clockwise**, and *Luna* stirs her potion **counterclockwise**...

The gestural inferences in the two examples above do not project, even though the two gestural inferences in either example do not contradict each other, so the simple reasoning described in the previous subsection is insufficient to account for their non-projection. Instead, the gestures in the examples above behave like ordinary modifiers under focus in a CT+F configuration, i.e., the prosodic prominence co-occurring with each word-gesture pair signals semantic focus on the gesture rather than on the verbal expression. Intuitively, the reason why prominence has to associate with the gestures in both examples is because the verbal content of the two items under prominence in each example is non-contrastive, and there is a general requirement for all F-items within a CT+F coordinated structure to contrast with each other:

\(^5\)Buckbeak is a hippogriff, and Fang is a dog.

\(^6\)Flitwick is a part-goblin and thus very short, so the inference that if he brings a dog to the Yule ball, it will be a small one would be a natural one.
(11) #Hermione petted Buckbeak, and Luna petted Buckbeak.

At this point I will not offer a comprehensive story about what it means for two expressions to be contrastive (but see, e.g., Katzir, 2014 for a discussion). For the purposes of this paper, let us assume the—inevitably simplified—view that for any two expressions \( \alpha \) and \( \beta \) of the same semantic type ending in \( t \), \( \alpha \) and \( \beta \) are properly contrastive if neither entails the other (assuming generalized entailment), and \( \alpha \) and \( \beta \) of type \( e \) are contrastive if \( \llbracket \alpha \rrbracket \neq \llbracket \beta \rrbracket \). Similarly, I will not engage in a discussion about the nature and status of this contrast requirement on \( F \)-items in CT+F coordinated structures. I will just assume that it holds, at least in the examples above (but see van Rooij, 2010; Büring, 2016 for a potentially relevant discussion).

One could try to rebut the contrast-based intuition above by arguing that the gestures in (9) and (10) give rise to more general inferences; e.g., a dog \( ^{\text{SMALL}} \) in Hagrid brings a dog \( ^{\text{SMALL}} \) does not give rise to an inference about the size of a dog Hagrid would bring but rather about the size of dogs in general. If that is the case, then the inferences of a dog \( ^{\text{SMALL}} \) and a dog \( ^{\text{LARGE}} \) would be contradictory, and thus the reasoning from the previous subsection could derive non-projection in (9) without appealing to any focus-related considerations. To use the same argument for (10), one would have to assume that the gestures in (10) necessarily attach to the verb \textit{stirs} rather than the whole VP \textit{stirs her potion}, since the two VPs do not have the same semantics due to the different indices on the pronouns. This reasoning would predict that mere co-occurrence of mutually exclusive gestures with the same predicate within one utterance should force non-projection. However, this prediction is not borne out; once we remove prominence from the word-gesture pairs, either by getting rid of the CT+F configuration altogether or by making something else the \( F \)-items, the gestural inferences can project:

(12) If \textbf{Flitwick} brings a dog \( ^{\text{SMALL}} \), and \textbf{Hagrid} brings a dog \( ^{\text{LARGE}} \), they’ll fight. 
    \[ \rightarrow \text{If } \langle \text{Flitwick}, \text{Hagrid} \rangle \text{ brings a dog, it will be a } \langle \text{small, large} \rangle \text{ one.} \]

(13) If \textbf{Hermione} stirs her potion \( ^{\text{CLOCKWISE}} \), and \textbf{Luna} stirs her potion \( ^{\text{COUNTERCLOCKWISE}} \), there will be an explosion.
    \[ \rightarrow \text{If } \langle \text{Hermione, Luna} \rangle \text{ stirs her potion, she’ll do so } \langle \text{clockwise, counterclockwise} \rangle. \]

(A sample context: Hermione and Luna are brewing potions next to each other; Hermione’s potion requires stirring clockwise, and Luna’s potion requires stirring counterclockwise; stirring two nearby potions in different directions causes an explosion.)

This observation suggests that even if gestures can give rise to generic inferences about predicates, more narrow inferences are certainly also possible.

Furthermore, one could speculate that focus-marking prosodic prominence co-occurring with a gesture always makes it at-issue, without any additional contrast considerations. This, however, is not the case either. Once we make the verbal content of the word-gesture pairs under focus-marking prominence within a CT+F coordinated structure contrastive, as in (14), the prominence can associate with the verbal content. Co-speech gestures do not like to be at-

\[ \text{With the caveat that the contrast between the two gestures might be interpreted as an inconsistency in the default stirring gesture (see fn. 4), in which case the direction of movement would not be interpreted iconically.} \]
issue unless under pressure, so the prominence will in fact preferably associate with the verbal content, thus, no longer forcing the gestures to be at-issue.\(^8\)

\[(14)\] If *Hagrid* brings a \([\text{dog}]_F^{\text{LARGE}}\), and *Filch* brings a \([\text{cat}]_F^{\text{SMALL}}\), they’ll fight.

\[\rightarrow\] If \(\langle\text{Hagrid, Filch}\rangle\) brings a \(\langle\text{dog, cat}\rangle\), it will be \(\langle\text{large, small}\rangle\).\(^9\)

Here is also a naturally occurring example of this configuration produced by a Parisian guide:

\[(15)\] If you’re going for a coffee\(^{\text{SMALL}}\). You know, if you’re going for a *real* coffee\(^{\text{SMALL}}\), not a Starbucks coffee\(^{\text{LARGE}}\)...

\[\rightarrow\] \(\langle\text{Real, Starbucks}\rangle\) coffees are \(\langle\text{small, large}\rangle\).

So, as an intermediate summary: when a prosodically F-marked element within a CT+F coordinated structure is a word-gesture pair, the at-issue interpretation of the gesture is only forced when the verbal content in that pair does not properly contrast with the other F-items.

Now, does the same generalization apply to lexical presuppositions? One problem is that we can usually only speculate what the at-issue/not-at-issue content of a given trigger is. That said, let us look at *start* and *stop*. One option is that they contrast in both at-issue and presuppositional content: for *start P* the two components are, roughly, ‘P now’ and ‘not P before’, and for *stop P* they are ‘not P now’ and ‘P before’. If the generalization above applies to lexical presuppositions, having *stop* and *start* as prosodically F-marked elements within a CT+F coordinated structure should not force local accommodation, which indeed seems to be the case.\(^{10}\)

\[(16)\] If *Umbridge* stopped drinking firewhisky, and *McGonagall* started doing so, we’re in trouble.

\[\rightarrow\] \(\langle\text{Umbridge, McGonagall}\rangle\) used to \(\langle\text{drink, not drink}\rangle\) firewhisky.

Now let us look at another pair of lexical items, *know* and *think*, which can be construed as having the same at-issue content but differing in their not-at-issue content, with *know* but not *think* triggering a factive presupposition. If that is correct, the generalization above predicts local accommodation when the two are prosodically F-marked elements in a CT+F coordinated structure. It seems indeed that the inference typically triggered by *know* in non-contrastive contexts does not obtain when *know* is contrasted with *think* in a CT+F coordinated structure:

\[(17)\] a. If Hermione knows that her parents are in danger, she’ll talk to Dumbledore.

\(^8\)It is as of now unclear to me what is the cause and what is the effect here. It might very well be that co-speech gestures are preferably not-at-issue precisely because it is harder for focus-marking prominence to associate with them, which, given certain assumptions about givenness, can very well result in default projection.

\(^9\)Here it is quite natural to get a secondary generic inference that dogs are in general larger than cats.

\(^{10}\)Local accommodation, of course, is still possible, e.g., in a context similar to the one in (2).
Hermione’s parents are in danger.

b. If Ron thinks that his parents are in danger, and Hermione knows that hers are, they’ll talk to Dumbledore.

∥ Hermione’s parents are in danger.

There is an apparent problem with a local accommodation approach to (17b), though, since (17b) does not really have the reading whereby the complement of know is a conjunct under if:

(18) If Ron thinks that his parents are in danger, and Hermione’s parents are in danger and she thinks that they are, Ron and Hermione will talk to Dumbledore.

Instead, (17b), intuitively, seems to suggest a contrast in how much evidence about their parents being in danger Ron and Hermione respectively need before they talk to Dumbledore, regardless of whether their parents actually are in danger. There have been some attempts to revisit the lexical semantics of know in terms of the level of certainty of the attitude holder or amount of evidence available to them (see, e.g., Wiegand, 2018 for a recent discussion). However, as things stand, those accounts are insufficient to predict the nature of inferences triggered by know and their projection behavior in all environments; in particular, they do not account for (17a). One (perhaps unsatisfying) possibility would be to say that know is lexically ambiguous between a factive, presupposition-triggering predicate, whose at-issue content is roughly equivalent to that of think, and a non-factive, non-presuppositional predicate meaning something like ‘believe with a great amount of certainty/evidence’—as opposed to think, which would mean something like ‘believe with a moderate amount of certainty/evidence’. As things stand, both readings would be predicted to be possible in non-contrastive environments (so, if there is a preference for the factive reading, something additional needs to be said), but the second reading would become much more salient when know is contrasted with think.

Setting the peculiarities of attitude predicates aside, it would seem that the data for some lexical presupposition triggers, in particular, start/stop and know, are compatible with the generalization made for co-speech gestures. The content that would normally project does not do so and is instead treated as part of the at-issue content (via local accommodation or lexical adjustments) when it is necessary to make the necessarily at-issue F-items within a CT+F coordinated structure contrastive. When the contrast requirement can be satisfied by some other content, the typically not-at-issue content, both gestural and presuppositional, can remain not-at-issue.

3.3. Not-at-issue focus

Let us now turn to focus that does not require at-issueness of the content it targets. Such focus marks novelty of certain content without having it address the QUD, for example:

(19) (IP If Flitwick brings a dog), (IP which will be small), (IP and Hagrid, too,) brings a dog), (IP which will be large), (IP they’ll fight).

→ If (Flitwick, Hagrid) brings a dog, it will be (small, large).

The focus-marking prominence on hers is not-at-issue focus, discussed in the next subsection.
(20) \((IP\ \text{If}\ \text{Hermione}\ \text{stirs}\ \text{her}\ \text{potion}), (IP\ \text{which}\ \text{she’ll}\ \text{do}\ \text{clockwise}), (IP\ \text{and}\ \text{Luna}\ \text{stirs}\ \text{her}\ \text{potion}), (IP\ \text{which}\ \text{she’ll}\ \text{do}\ \text{counterclockwise}), (IP\ \text{there}\ \text{will}\ \text{be}\ \text{an}\ \text{explosion})\).\ 
\quad \rightarrow \ \text{If}\ \langle\text{Hermione, Luna}\rangle\ \text{stirs}\ \text{her}\ \text{potion}, \text{she’ll}\ \text{do}\ \text{so}\ \langle\text{clockwise, counterclockwise}\rangle.\)

Note that the ARCs in the two examples above are not F-items in CT+F coordinated structures; (19) is an instance of additive coordination (which can be highlighted by adding an overt additive particle \textit{too}), and in (20) the F-items are the two \textit{her} pronouns with distinct antecedents. In fact, true appositives cannot be F-items in a CT+F configuration at all. ARCs, and appositives more generally, are packaged into their own IPs (see Selkirk, 2005 and references therein). Trying to impose CT+F prosody on the strings in (19) would change prosodic grouping, resulting in a restrictive RC interpretation (which in this case will also require tense changes in the RCs):

\[
(21) \quad (IP\ \text{If}\ \text{Flitwick}\ \text{brings}\ \text{a}\ \text{dog}\ \text{which}\ \text{is}\ \text{small}), (IP\ \text{and}\ \text{Hagrid}\ \text{brings}\ \text{a}\ \text{dog}\ \text{which}\ \text{is}\ \text{large}), (IP\ \text{they’ll}\ \text{fight}). \quad 12
\]
\[
\not\rightarrow \ \text{If}\ \langle\text{Flitwick, Hagrid}\rangle\ \text{brings}\ \text{a}\ \text{dog}, \text{it}\ \text{will}\ \text{be}\ \langle\text{small, large}\rangle\ \text{one}.
\]

Note that something similar happens with post-posed nominal adjuncts; (22a) has two bona fide non-restrictive nominal appositives, while in (22b) the adjuncts are interpreted as restrictive modifiers and require existence of two salient Fangs:

\[
(22) \quad a. \quad (IP\ \text{If}\ \text{Filch}\ \text{brings}\ \text{Mrs}\ \text{Norris}), (IP\ \text{a}\ \text{small}\ \text{beast}), (IP\ \text{and}\ \text{Hagrid}\ \text{brings}\ \text{Fang}), (IP\ \text{a}\ \text{large}\ \text{beast}), (IP\ \text{they’ll}\ \text{fight}). \quad 13
\]
\[
b. \quad (IP\ \text{If}\ \text{Flitwick}\ \text{brings}\ \text{Fang}\ \text{the}\ \text{small}\ \text{beast}), (IP\ \text{and}\ \text{Hagrid}\ \text{brings}\ \text{Fang}\ \text{the}\ \text{large}\ \text{beast}), (IP\ \text{they’ll}\ \text{fight}).
\]

While it might be tempting to say that the restrictive interpretations of the adjuncts in (21) and (22b) are instances of local accommodation of appositives, the prosodic, morphosyntactic, and lexical changes alone suggest different structures to begin with. In fact, as I will show in the next section, local accommodation of adnominal appositives would yield different readings from those of restrictive modifiers but is for the most part impossible.

Interestingly enough, similar not-at-issue focus can be argued to be possible for what Ebert and Schlenker call \textit{post-speech gestures}, i.e., gestural adjuncts that follow the verbal expressions they adjoin to (even though the utterances below are quite awkward to pronounce, presumably due to the fact that post-speech gestures like to be utterance-final):

\[
(23) \quad (IP\ \text{If}\ \text{Flitwick}\ \text{brings}\ \text{a}\ \text{dog}) — (IP\ \text{small}), (IP\ \text{and}\ \text{Hagrid}\ \text{brings}\ \text{a}\ \text{dog}) — (IP\ \text{large}), (IP\ \text{they’ll}\ \text{fight}).
\]
\[
\rightarrow \ \text{If}\ \langle\text{Flitwick’s, Hagrid’s}\rangle\ \text{brings}\ \text{a}\ \text{dog}, \text{it}\ \text{will}\ \text{be}\ \langle\text{small, large}\rangle.
\]

\[
(24) \quad (IP\ \text{If}\ \text{Hermione}\ \text{stirs}\ \text{her}\ \text{potion}) — (IP\ \text{clockwise}), (IP\ \text{and}\ \text{Luna}\ \text{stirs}\ \text{her}\ \text{potion}) — (IP\ \text{counter-clockwise}), (IP\ \text{there}\ \text{will}\ \text{be}\ \text{an}\ \text{explosion}).
\]
\[
\rightarrow \ \text{If}\ \langle\text{Hermione, Luna}\rangle\ \text{stirs}\ \text{her}\ \text{potion}, \text{she’ll}\ \text{do}\ \text{so}\ \langle\text{clockwise, counterclockwise}\rangle.
\]

\begin{itemize}
\item \textit{which} as a relativizer in restrictive RCs and need to also replace \textit{which} with \textit{that} here.
\item \textit{Mrs Norris} is a cat.
\end{itemize}
Ebert has at different points argued that post-speech gestures can have at-issue (Ebert and Ebert, 2014) or “parenthetical” (Ebert, 2017) semantics. Schlenker (2018) claims that post-speech gestures are “supplements”, which is compatible with them being more like either appositives or parentheticals. For the purposes of this paper, these differences do not matter. What matters is that, with regard to the possibility of bearing not-at-issue focus, not-at-issue post-speech gestures pattern with other prosodically independent not-at-issue content.

A natural question at this point is if there are counterparts of (21) and (22b) for post-speech gestures, i.e., if we can have an example with gestures linearly following the verbal expressions they adjoin to but still in the same IP as those verbal expressions. The answer seems to be ‘no’. For example, the following string is very hard to pronounce:

\[(25) \text{If Flitwick brings a dog — SMALL), (IP and Hagrid brings a dog — LARGE), (IP they’ll fight).}\]

There seems to be an articulatory constraint on gestures that requires that once they share an IP with some verbal content they should be anchored to some vocal prosodic event, such as pitch accents in languages like English, i.e., they have to be linearized as what we have been so far calling co-speech gestures. In other words, there are two major articulatorily non-taxing possibilities for alignment of gestures: as prosodically independent items in their own IPs or as prosodically dependent items within verbal IPs.

Now, going back to not-at-issue focus, it is easy to see that the interpretations of the sentences in (19)/(23) and (20) are essentially the same as in (12) and (13) (repeated below), respectively:

\[(12) \text{If Flitwick brings a dog } \text{SMALL}, \text{ and Hagrid, too,) brings a dog } \text{LARGE}, \text{ they’ll fight.}\]

\[(13) \text{If Hermione stirs her potion } \text{CLOCKWISE, and Luna stirs her potion } \text{COUNTERCLOCKWISE, there will be an explosion.}\]

The difference, however, is in how prominence is marked. Intuitively, it is OK to mark prominence on contrastive ARCs or post-speech gestures, since they are in their own IPs. Trying to mark co-speech gestures as prominent in (12) or (13) is awkward, possibly because it creates a confusing or even garden-path environment regarding the structure, since the prosodic differences between CT+F and additive coordination in this case are very subtle. However, some speakers accept not-at-issue focus on the second word-gesture pair only in (12) and (13).

---

14 It is not entirely clear to me how “parenthetical” post-speech gestures are different from “supplemental” co-speech gestures, considering that Potts calls both appositives and parentheticals supplements (Potts, 2005, p. 6).

15 Certainly not all gestures that follow some verbal material are not-at-issue. Some of them can be independent standalone utterances that have ordinary at-issue semantics. Some can have elaboration at-issue uses similar to those of one appositives (discussed, for example, in Nouwen, 2014):

(i) Bring me a beer, a small one.
(ii) Bring me a beer — SMALL.

Yet, the gestures in (23) and (24) seem to be making a contribution similar to that of ordinary appositives.

16 For example, Loehr (2004) shows that apexes of gesture strokes tend to align with pitch accents in English.
Now, what happens to presupposition triggers? One observation is that two different lexical items with the same (purported) at-issue content and different (purported) presuppositional content cannot participate in additive coordination, regardless of how prominence is marked:

(26) *If Ron thinks that his parents are in danger, and Hermione, too, knows that hers are, they’ll talk to Dumbledore.

This is presumably because the additive presupposition of too cannot ignore sublexical not-at-issue content,\(^{17}\) i.e., too in (26) triggers the presupposition that Ron knows that his parents are in danger, not that he thinks that they are, which is not satisfied in the context. The presupposition of too can ignore lexically independent not-at-issue content such as gestures (whether co- or post-speech) and appositives, which allows them to participate in additive coordination. A similar generalization applies to how different types of not-at-issue content behave under ellipsis. Note that these facts require an additional explanation under Schlenker’s presuppositional analysis of co-speech gestures, but this discussion is well beyond the scope of this paper.

That said, some people can to some extent accept the following utterance, without an additive particle and with not-at-issue focus on knows only (although the judgements are hard):

(27) **Context:** McGonagall doesn’t know if Ron’s parents are in danger, but she knows that Hermione’s are; she doesn’t know what Ron and Hermione think; she says: If Ron thinks that his parents are in danger, and Hermione knows that hers are, they’ll talk to Dumbledore.

The take-home message of the last two subsections is that a major factor in how focus interacts with a given type of not-at-issue content is whether that content is prosodically independent. Co-speech gestures are prosodically anchored to the verbal content they share an IP with, and lexical presuppositions are a sublexical component of a lexical item that also contains some at-issue content;\(^{18}\) as a result, it is hard for them to bear not-at-issue focus, but they can serve as F-items in CT+F coordinated structures (and sometimes they have to). Appositives and post-speech gestures necessarily occupy their own IPs; as a result, they can bear not-at-issue focus but cannot be F-items in CT+F coordinated structures. Additionally, there might be subtler differences between lexically dependent (presuppositions) and lexically independent (gestures) not-at-issue content regarding not-at-issue focus, but the data are somewhat messy. Next I will show that some not-at-issue content cannot be locally accommodated even as a last resort.

3.4. When local accommodation is impossible

Let us start with an observation that appositives adjoining to nominals do not have the semantics of restrictive modifiers but instead contribute a proposition about the DP they associate with:

\(^{17}\)A notorious exception are gender features, which have often been given a presuppositional analysis but can be famously ignored under ellipsis and in additive coordination; I will not have much to say about this.

\(^{18}\)Except triggers like too and again, which arguably only contribute presuppositional content. Interestingly enough, these triggers are typically considered “strong” in the sense that they do not easily allow for local accommodation in the first place, regardless of focus placement. Why this is so is beyond the scope of this paper.
(28)  a.  (IP Hagrid brought his dog), (IP who is large).
≈ Hagrid brought his dog, and, by the way, his dog is large.

b.  (IP Hagrid brought his dog), (IP a large beast).
≈ Hagrid brought his dog, and, by the way, his dog is a large beast.

To know if this content can be at-issue, we want to see if those propositions can be treated as maximally local conjuncts. As it happens, they typically cannot, not even as a last resort: 19

(29)  Context: Hermione knows that Hagrid has a single dog, but she doesn’t know how big that dog is. Hagrid is planning to bring his dog to the Yule ball. Hermione says:

a.  #(IP If Hagrid brings his dog), (IP who is small), (IP it’s gonna be OK), (IP but if he brings his dog), (IP who is large), (IP it’s gonna be a mess).

b.  #(IP If Hagrid brings his dog), (IP a small beast), (IP it’s gonna be OK), (IP but if he brings his dog), (IP a large beast), (IP it’s gonna be a mess).

No antecedent in (29) can have a reading along the lines of ‘If Hagrid brings his dog and his dog is (a) {small, large} (beast)...’, even though that would have made the sentences meaningful. Surprisingly enough, such propositional readings cannot be accommodated for gestures either, regardless of whether they are linearized as co-speech or post-speech:

(30)  Same context as in (29).

a.  #(IP If Hagrid brings his dog\textsuperscript{SMALL}), (IP it’s gonna be OK), (IP but if he brings his dog\textsuperscript{LARGE}), (IP it’s gonna be a mess).

b.  #(IP If Hagrid brings his dog) — (IP small), (IP it’s gonna be OK), (IP but if he brings his dog) — (IP large), (IP it’s gonna be a mess).

Note that the co-speech gestures in (30a) could get a restrictive modifier interpretation in a different context (one in which Hagrid has at least two dogs, one small and one large), but the post-speech gestures in (30b) cannot (for reasons discussed in the previous subsection).

So, to sum up the data on when local accommodation is possible and when it is not: adnominal appositives and post-speech gestures always have propositional semantics and cannot be locally accommodated; adnominal co-speech gestures can be accommodated when they have predicative semantics but not when they have propositional semantics.

A natural question is whether similar restrictions apply to lexical presuppositions, i.e., if only predicative, but not propositional presuppositional content can be locally accommodated. Since we can typically only speculate about the exact form of the presuppositional content in any given case, it is hard to talk about its semantic type, and I will not attempt to do so here. That said, the analysis I sketch in section 4.2 suggests that it is not the propositional type of a given

\footnote{Schlenker (2013) discusses some apparent exceptions for ARCs:
(iv)  If tomorrow I call the Chair, who in turn calls the Dean, then we will be in deep trouble.
\textbar  If tomorrow I call the Chair, they will call the Dean.
≈ If tomorrow I call the Chair, and they call the Dean...
Such examples routinely involve a description of a sequence of events; since they would be hard to, if not impossible, to replicate with gestures, I do not discuss them in this paper.}
3.5. Summary of the data

Table 1 summarizes the data discussed in this section (with some simplifications).

<table>
<thead>
<tr>
<th>content type</th>
<th>structural properties</th>
<th>semantic type</th>
<th>at-issue interpretations</th>
<th>not-at-issue focus</th>
</tr>
</thead>
<tbody>
<tr>
<td>appositives</td>
<td>prosodically independent; lexically independent</td>
<td>propositional</td>
<td>impossible</td>
<td>possible</td>
</tr>
<tr>
<td>post-speech gestures</td>
<td>prosodically independent; lexically independent</td>
<td>propositional</td>
<td>impossible</td>
<td>possible</td>
</tr>
<tr>
<td>co-speech gestures</td>
<td>prosodically dependent; lexically independent</td>
<td>predicative or propositional</td>
<td>can be forced for predicative gestures as a last resort; impossible for propositional gestures</td>
<td>hard</td>
</tr>
<tr>
<td>lexical presuppositions</td>
<td>prosodically independent; lexically dependent</td>
<td>??</td>
<td>can be forced as a last resort (for some triggers)</td>
<td>hard</td>
</tr>
</tbody>
</table>

Table 1: Different types of not-at-issue content: summary

In the next section I will discuss what issues these data raise for Ebert’s and Schlenker’s analyses of gestures and sketch an alternative analysis that avoids these issues.

4. Analyses of gestures

4.1. Issues for Ebert’s and Schlenker’s analyses

As I have said before, the differences (if any) between Ebert’s and Schlenker’s analyses of post-speech gestures do not matter for the data at hand. As far as both analyses predict that post-speech gestures cannot be locally accommodated, these data pose no problems for them.

Ebert’s (2017) analysis of co-speech gestures is two-fold. She claims that co-speech gestures in general have supplemental semantics akin to that of appositives, but she also allows for NP-level gestures with “exemplification” semantics. In other words, under her view, for example, *a dog_LARGE* typically has the same semantics as *a dog, (IP which is/will be large)*, but—if my...
understanding of her claims is correct—the gesture \textit{LARGE} can also sometimes be interpreted as indicating the size of a typical entity in the denotation of the predicate \textit{dog}.

As things stand, it is unclear if this view can predict the restrictive modifier interpretations of predicative co-speech gestures under pressure (as in (5), (7), (9), or (10)). As we have seen in the previous section, appositives only have propositional semantics, so even if they were capable of being locally accommodated (which they do not seem to be), the predicted readings would not be those of restrictive modifiers. As for “exemplification” interpretations, it is unclear to me if they can be at-issue and what the predicted result would be, if they can.

Schlenker (2018) argues that co-speech gestures trigger assertion-dependent presuppositions he calls \textit{cosuppositions}. A gestural cosupposition has the form $V \Rightarrow G$, where $V$ is the verbal expression the gesture adjoins to, $G$ is the gesture’s content, and $\Rightarrow$ is generalized entailment. When this cosupposition projects, the local context $c'$ of $[[V][G]]$ has to entail it: $c' \Rightarrow (V \Rightarrow G)$. When it is locally accommodated, it is conjoined to $V$: $V \& (V \Rightarrow G)$, which is equivalent to $V \& G$, where $\&$ is generalized conjunction. Note that for Schlenker’s cosuppositional mechanism to apply, it is crucial that the denotations of $V$, $G$, and $c'$ are all of the same type.

Without going into technical details, given certain assumptions about how local contexts are computed, Schlenker’s cosuppositional analysis yields correct predictions for adnominal \textit{et}-type co-speech gestures when they adjoin to \textit{et} expressions, i.e., NPs, both for projection and local accommodation. For example, the following results obtain for \textit{Hagrid brings his dog \textit{LARGE}}, if the gesture adjoins to the NP \textit{dog}: if the cosupposition projects, we get a conditional inference, roughly, ‘If Hagrid brings his dog, his dog is large’ (from which it is easy to generalize to ‘Hagrid’s dog is large’ tout court); if the cosupposition is accommodated, we get the at-issue content of the sentence to be ‘Hagrid brings his large dog’, which is exactly what we want.

Things become more complicated when gestures adjoin to expressions of type $\langle \textit{et}, t \rangle$ or $e$, i.e., DPs. If all co-speech gestures trigger presuppositions, which seems to be Schlenker’s claim, we have to assume that DP-level co-speech gestures are of the same type as the DP they adjoin to. Depending on our further assumptions about the denotation of the gesture and the local context, the cosuppositional mechanism can yield similar results for DP-level attachment of the gesture as for NP-level attachment when it comes to projection. However, as things stand, we will also predict local accommodation to be possible in this case. The exact result for local accommodation will depend on what denotation we assume for the DP-level gesture. For example, if we assume that a DP-level gesture \textit{LARGE} denotes an existential quantifier ‘a large object’, we get the at-issue content of the sentence to be ‘Hagrid brings his dog and a large object’. If we introduce an anaphoric link across the verbal expression \textit{his dog} and the gesture \textit{LARGE}, we can get the at-issue content of the sentence to be ‘Hagrid brings [his dog]$_i$ and it$_i$ is large’. Neither is attested.

More generally, since the only attested at-issue interpretation of adnominal gestures is that of restrictive \textit{et} modifiers, we should find a way to block any other at-issue interpretations. If one wants to maintain Schlenker’s claim that all co-speech gestures trigger cosuppositions, they would have to stipulate either that adnominal co-speech gestures can only attach to \textit{et expres-
sions, or that only et adnominal co-speech gestures can be locally accommodated. Neither option seems to be well-motivated. Furthermore, under such an approach, the fact that both post-speech gestures and non-predicative co-speech gestures cannot be locally accommodated seems entirely accidental. In the next subsection I will sketch an analysis of gestures, focusing specifically on adnominal gestures, that does not assume that the linearization of a gesture directly determines its semantics. Instead, I will propose that the semantics and projection properties of a gesture are determined by its level of attachment in the syntax, which will also restrict its linearization possibilities.

4.2. Proposal: syntax/semantics and syntax/prosody of gestures

I will assume that all NP-level adjuncts, gestural or not, denote predicates of et type (which is not particularly controversial), and all DP-level adjuncts, gestural or not, denote propositions containing a pronoun anaphoric to the DP the adjunct merges with in the narrow syntax. This latter assumption is quite natural to make for ARCs and nominal appositives (which for our purposes can be just reduced ARCs), and I am generalizing it to DP-level gestures. For example, an NP-level gesture LARGE denotes λx.large(x), but a DP-level gesture LARGE denotes large(x), where x is anaphoric to the DP the gesture adjoins to.

Now, Schlenker’s cosuppositional mechanism can apply to NP-level gestures, because they have the same type as the verbal expression they modify. When the cosupposition projects, we get a conditional, assertion-dependent inference; when it is accommodated—in particular, to satisfy the contrast requirements under focus—the gesture behaves as a restrictive modifier.

However, the cosuppositional mechanism cannot apply to DP-level gestures, since they are not of the same type as the DP they adjoin to. More generally, DP-level adjuncts cannot be interpreted where they merge in the narrow syntax. Instead, they have to raise at LF and adjoin at some sentential level. As a first approximation, they adjoin at the highest possible level at which the discourse referent introduced by the DP they originally merged with is still available for them. Further assumptions about the status of not-at-issue DP-level adjuncts might be needed to derive their projection behavior when they do not end up having matrix scope even after raising. For example, Schlenker’s (2013) semantic translucency of appositives will do the job (Schlenker’s treatment of appositives is in general very much in line with the story I’ve been developing here, modulo some differences in syntactic assumptions). Regardless of those further assumptions, however, this general approach makes the mechanism of local accommodation, i.e., conjunction at the level of “triggering”, inapplicable to DP-level adjuncts.

This story gives us a principled reason why different mechanisms apply to NP- vs. DP-level gestures, with potentially different results when it comes to at-issue interpretations. But how do we explain why post-speech adnominal gestures seem to be incapable of having predicative semantics and, subsequently, at-issue interpretations? I propose that that is because NP-level gestures cannot be linearized as post-speech due to articulatory and prosody/syntax constraints. There are two conflicting requirements that ensure this result. On the one hand, NP-level adjuncts want to be in the same IP as the NPs they adjoin to (we have seen this, for example,
for restrictive RCs and postposed restrictive nominal modifiers). However, as we have seen in Section 3.3 (example (25) and discussion thereof), once a gesture is in an IP with some at-issue content, it cannot be prosodically independent due to articulatory reasons, i.e., it has to be co-speech. These two requirements can be formulated as OT-style constraints:

(31) **ANCHOR**G: Assign * for each gesture that is inside an IP containing verbal content but is not anchored to any vocal prosodic event.

(32) **WRAP**NP (a narrow version of Truckenbrodt, 1999’s **WRAP**XP constraint): Assign * for each IP boundary inside an NP.

The constraints above are in principle violable, but since there is always a better candidate, with the NP-level gesture linearized as co-speech, post-speech NP-level gestures should not emerge:

\[
\begin{array}{|c|c|}
\hline
[D [NP GESTURE]] & ANCHORG \leftrightarrow WRAPNP \\
\hline
a. (IP...D NP GESTURE...) & \text{ } \\
b. (IP...D NP — GESTURE...) & *! \\
c. (IP...D NP) — (IP GESTURE) & *! \\
\hline
\end{array}
\]

Since DP-level gestures packaged into their own IPs do not violate WRAPNP, DP-level gestures can be linearized either as co-speech or post-speech:

\[
\begin{array}{|c|c|}
\hline
[[D NP GESTURE]] & ANCHORG \leftrightarrow WRAPNP \\
\hline
a. (IP...D NP GESTURE...) & \text{ } \\
b. (IP...D NP — GESTURE...) & *! \\
c. (IP...D NP) — (IP GESTURE) & \text{ } \\
\hline
\end{array}
\]

Here I am not committing to any specific constraint-based theory (the tableaux above are done in the style of the classical OT for simplicity). However, if we want to capture both variation and gradience in judgements, which is especially pertinent when dealing with gestures, theories that place constraints on a numerical scale, such as stochastic OT (Boersma, 1997 et seq.), or have weighted constraints, such as Harmonic Grammar and variations thereof (Legendre et al., 1990 et seq.), might be better suited than the classical OT (Prince and Smolensky 1993/2004).

5. Conclusion

In this paper I have looked at how different types of not-at-issue content interact with contrastive focus. In particular, I have tried to address the following questions:

1. When do focus-related considerations force at-issue interpretations of typically not-at-issue content?
2. Can a given type of content bear the so-called not-at-issue contrastive focus (i.e., focus that marks contrast without addressing the QUD)?
3. When are at-issue interpretations of a given type of content impossible, even when that would be the only way to satisfy contrast requirements?
Regarding Question 1, I have looked at cases when the semantically focused element has to be addressing the immediate QUD and thus has to be at-issue, as is the case for F-items in a CT+F configuration. I have shown that at-issue interpretations of typically not-at-issue content are forced in this case only if it is necessary to make the F-items properly contrastive across the conjuncts. These considerations apply to prosodically dependent not-at-issue content only, namely, co-speech gestures and lexical presuppositions. Prosodically independent content, such as appositives and post-speech gestures, cannot be an F-item in a CT+F configuration.

Regarding Question 2, I have observed that it is much easier for prosodically independent not-at-issue content to bear not-at-issue contrastive focus. There also seem to be further subtle differences between lexically independent (co-speech gestures) and lexically dependent (presuppositions) content with respect to not-at-issue focus, which need to be investigated further.

The answers to the first two questions group together lexical presuppositions and co-speech gestures on the one hand and appositives and post-speech gestures on the other, which goes in line with Schlenker’s (2018) analysis of gestures (contra Ebert and Ebert, 2014; Ebert, 2017), even though it is unclear whether this patterning reveals anything about the semantics of the types of content at hand rather than the role of their structural properties.

The answer to Question 3, however, emphasizes the role of said structural properties for at least appositives and gestures, since only those adnominal adjuncts that match the phrase they adjoin to in semantic type (in particular, predicative co-speech gestures) can have at-issue interpretations under pressure. Adnominal appositives, post-speech gestures, and propositional co-speech gestures cannot have at-issue interpretations even under pressure. Taking this observation as a pivotal point, I have sketched an analysis of adnominal gestures whereby NP-level gestures are predicative and thus can be locally accommodated by conjoining with the NP they adjoin to, but DP-level gestures are propositional, like appositives, and thus cannot be locally accommodated. I have further proposed that DP-level gestures can be linearized as either co- or post-speech, but NP-level gestures can only be linearized as co-speech, due to articulatory and prosody/syntax constraints. A natural next step is to extend this approach to adverbial gestures.

References


Partition by exhaustification: Comments on Dayal 1996
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Abstract. In this paper I argue for a new constraint on questions, namely that a question denotation (a set of propositions) must map to a partition of a Stalnakerian Context-Set by point-wise exhaustification (point-wise application of the function Exh). The presupposition that Dayal attributes to an Answer operator follows from this constraint, if we assume a fairly standard definition of Exh (Krifka, 1995). But the constraint is more restrictive thereby deriving the sensitivity of higher order quantification to negative islands (Spector, 2008). Moreover, when combined with recent proposals about the nature of Exh – designed primarily to account for the conjunctive interpretation of disjunction (e.g. Bar-Lev and Fox, 2017) – Dayal’s presupposition follows only in certain environments. This observation allows for an account of the “mention-some” interpretation of questions that makes specific distributional predictions.

Keywords: exhaustivity, Free Choice, maximality, higher-order quantification, mention-some, negative-islands, partition, scalar implicatures, uniqueness.

1. Introduction

According to Dayal (1996), a question denotation is a set of propositions (as in Hamblin, 1973) and an interrogative construction presupposes that one member of the set is true and entails all other true members (i.e. is a most informative true member). This maximality presupposition has been defended in two different ways. Frist, Dayal showed how it accounts for various inferential patterns: existence inference for plural constituent questions (which girls are here?) and uniqueness for their singular counterparts (which girl is here?). Second, later literature has pointed out that the maximality presupposition can also account for various constraints on question formation, most clearly for negative islands.

I will begin this paper with a new perspective on Dayal’s proposal. Under this perspective, the maximality presupposition is not taken as primitive but is derived instead from the demand that a complete answer to a question be identifiable by exhaustification. More specifically, I will propose that any possible complete answer to a question (every cell in the partition the question induces) must be derivable by the exhaustification of a member of the question denotation. This perspective invites two modifications in the presupposition, which, in turn, overcome two empirical challenges, one coming from the “mention-some” interpretation of questions (MS) and the other from a new form of extraction sensitive to negative islands (Spector, 2008). MS can be explained when the demand of cell-identification is combined with recent proposals in the theory of exhaustification. The sensitivity to negative islands is explained by strengthening cell-identification, demanding that

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2 See Fox and Hackl, 2006; Abrusán and Spector, 2011; Abrusán, 2007, 2014. For other islands that might have a semantic account see Abrusán, 2007, 2014; Oshima, 2007; and Schwarz and Simonenko, 2016.
exhaustification yield a mapping from question denotation onto the partition. The resulting picture can then be redrawn (as pointed out to me by Roger Schwarzschild). Specifically, we can dispense with the standard definition of the partition-induced-by-a-question and simply demand that (point-wise) exhaustification partition the context-set.

1.1. The duality of questions – an arithmetic challenge

When is a proposition relevant to a question (or when is it about the topic that the question introduces)? When is it informative relative to the question? When does it provide a complete or a partial answer? These issues, which are central for various areas of pragmatics, can be addressed straightforwardly when we think of a question as a partition of a space of possibilities – Logical Space, or the Stalnakerian Context-Set. Entertaining a question involves a concern with locating oneself in a space of possibilities, where certain distinctions matter and others don’t. A partition is useful for describing such a concern. What matters given a partition (what is relevant) is what cell you’re in. So a proposition that distinguishes between cell members (true of some, false of others) will be irrelevant. If a proposition eliminates a cell, it will be informative (i.e. will provide a partial answer to the question), and if it eliminates all but one cell, it will be maximally informative, thus providing a complete answer. ³

(1) **Question Pragmatics** (Hamblin, Groenendijk and Stokhof, Lewis, etc.)

A Question characterizes a topic of conversation and as such tells us what is relevant, informative, orthogonal, etc.

→ **Question as Partition** (of a space of possibilities)

But since Heim (1994) there has been growing evidence that questions do not denote partitions. The arguments are by now quite involved (besides Heim, see also Guerzoni, 2003; Guerzoni and Sharvit, 2007, 2014; Klinedinst and Rothschild, 2011; Cremers and Chemla, 2016; Spector and Egré, 2015; Xiang, 2016). Heim’s original case can be illustrated through a comparison of certain questions that need to be associated with the same partition but, nevertheless, differ in their semantic properties. For example, the question who (among Mary, Sue and Jane) is here? has a different denotation from its negative counterpart: who (among Mary, Sue and Jane) is not here? This difference can be seen when looking at the different results obtained when embedding the two questions under the verb surprise: John is surprised by who is here means something different from John is surprised by who is not here.⁴ At the same time, the two questions determine the same partition, as no proposition can be relevant or informative relative to one of these questions without bearing the same relationship to the other.⁵

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³ For additional useful notions that can be elucidated with partitions, see Groenendijk and Stokhof, 1984; Lewis, 1987 and much subsequent work.

⁴ Heim concludes that the propositional argument of surprise must be the weakly exhaustive answer to the question. But Spector and Egré (2015) provide evidence for a more nuanced conclusion, which might be relevant later on (see note 39).

⁵ The argument can be appreciated most clearly when focusing on the de re reading of questions. On relevant complications that come from the de-dicto interpretations, see George, 2011. Throughout this paper I will be focusing on the de re interpretation.
So, as Heim pointed out, a partition does not provide enough information to explain the semantic contribution of a question to the meaning of an indicative sentence in which it is embedded. A popular response to this observation – the one advocated by Heim – is that questions denote sets of propositions (so called, Hamblin sets). These sets are not always mutually exclusive, and hence do not necessarily partition a set of possibilities.\(^6\)

(2) **Question Semantics** (Heim, Klinedinst and Rothschild, Cremers and Chemla, etc.)

Questions show an asymmetry between positive and negative information. Therefore, questions cannot denote partitions.

\[\Rightarrow \text{Question as Set of Propositions} \text{ (not necessarily mutually exclusive)}\]

Our questions *who is here?* and *who is not here?*, in particular, denote two different sets of mutually compatible propositions (\(\{p: \exists x \in A \ p = \lambda w. \ x \text{ is here in } w\}\) and \(\{p: \exists x \in A \ p = \lambda w. \ x \text{ is not here in } w\}\)). And the difference between these two sets suffices to explain the different consequences that arise when the two questions are embedded as arguments of *surprise*.\(^7\)

But since partitions are necessary for understanding question pragmatics (the function of a question in thought and communication), we need to derive them from question denotations. And this can be done in a very simple way (as pointed out by many). Specifically, if we have a set of propositions, \(Q\), we can partition Logical Space to sets of possibilities that agree with each other on the truth-value of members of \(Q\).

(3) **The partition of Logical Space induced by** \(Q\), \(\text{Partition}_L(Q)\) – henceforth the **Logical Partition**, is the set of equivalence classes of \(W\) under the relation

\[w \sim w' \text{ iff } \forall p \in Q[p(w) = p(w')]\]

I’ll illustrate with a very simple case. Suppose we want to know which of two logically independent propositions, \(p\) and \(q\), are true. This can be restated as a desire to determine the truth-value of each of the two propositions, i.e., to locate ourselves in the partition \(P = \{\neg p \& \neg q, p \& \neg q, q \& \neg p, p \& q\}\). But if we want to express this desire, we might do so using a natural language expression with denotation \(Q = \{p, q\}\). Although this denotation is not a partition, the desired partition can be retrieved from it (\(P = \text{Partition}_L(Q)\)).

(4) \(Q = \{p, q\}\) where \(p\) and \(q\) are logically independent

\[\text{Partition}_L(Q) = \{\neg p \& \neg q, p \& \neg q, q \& \neg p, p \& q\}\]

This can serve to clarify the relationship between the two natural language questions mentioned above: the two questions (*who is here?* and *who is not here?*) denote two different sets of propositions (\(\{\text{that } a \text{ is here, that } b \text{ is here,\ldots}\}\) and \(\{\text{that } a \text{ is not here, that } b \text{ is not here,\ldots}\}\)); yet, by (3), the two sets induce the same partition.


\(^7\) For competing proposals about what it means to be surprised by \(Q\), see George 2011 (3.2), Heim, 1994; Lahiri, 2002, and Spector and Egrè, 2015.
So there are two different and indispensible notions of a question ((1) and (2)) – question duality. But there is a very simple way to connect them. The notion in (2) is the one delivered by grammar, and the notion in (1), necessary for pragmatics, is retrieved by the function in (3). All of this is simple enough. But now I would like to discuss a rather mundane observation about the typical relationship between questions and answers and suggest a way to think about it that leads to a problem. The problem, I will argue, is useful in understanding empirical constraints on questions. Specifically, I will argue that questions are unacceptable whenever this problem cannot be resolved.

Typically, a question with denotation Q is answered by a sentence denoting a proposition in Q. Yet the answer manages to convey a cell in the partition, by its exhaustive interpretation:

(5) Question: Who (among Jane, Mary and Sue) is here.
    Answer: Mary is here.
    (exhaustive interpretation: Mary is here and Sue and Jane aren’t.)

(6) Observation about Answers:
    A question, with denotation Q, is typically answered by a proposition p, such that p∈Q, hence is not, itself, a cell in Partition\textsubscript{1}(Q). Still p manages (by exhaustification) to identify a cell.

Imagine that we turn this observation into a principle:

(7) Question Answer Matching:\(^8\)
    A question whose denotation, Q, is a set of propositions must be answered by a single sentence whose basic denotation (prior to exhaustification) is a member of Q.

This principle, now, leads to an automatic arithmetic problem. Many questions will be unanswerable in many situations. For example, when Q has n logically independent proposition, Partition\textsubscript{1}(Q) will have \(2^n\) members:

(8) Question Answer Duality – an Arithmetic Problem:
    There will be cases in which cells in Partition\textsubscript{1}(Q) will not be identifiable by a member of Q (based on simple numerical considerations).

    Illustration: In (4), Q={p,q} contains 2 propositions yet Partition\textsubscript{1}(Q) contains 4:
    p, by exhaustification, is strengthened to p&¬q; q is strengthened to q&¬p
    The cells ¬p&¬q, p&q cannot be identified.

1.2. Dayal’s presupposition as a solution to an arithmetic challenge

As mentioned, Dayal argues that an interrogative construction presupposes that one member of the question denotation is true and entails all other true members (i.e. is a most informative

---

\(^8\) This condition is close to Rooth’s (1992) demand that the focus value of answer to a question be a super-set of the question denotation. However, Rooth’s principle allows a question to be answered by a sequence of sentences each of which satisfies his condition independently. For possible arguments that the condition needs to be satisfied by a single sentence, see Bade, 2016; Aravind and Hackl, 2017.
true member). This maximality presupposition is encoded in the meaning of an obligatory lexical item – Dayal’s answer operator, $Ans_D$. Every question must merge with $Ans_D$, yielding an interrogative construction that carries a maximality presupposition.

(9) **Dayal (1996):**
   a. $Ans_D(Q) = \lambda w: \exists p \in Q [p = \text{Max}_{\inf}(Q,w)]$. $\text{Max}_{\inf}(Q,w)$
   b. $\text{Max}_{\inf}(Q,w) = p$ iff $w \in p$ & $\forall q \in Q [w \in q \rightarrow p \subseteq q]$.

If the presupposition of $Ans_D$ is met, the arithmetic problem mentioned in (8) disappears. Suppose that $A$ is a Stalnakerian Context-Set (a set of worlds that satisfy what is presupposed in a conversational context). When an interrogative construction is used, the presupposition of $Ans_D$ will be met (by Stalnaker’s bridge principle), and every world in $A$ will satisfy a unique proposition of the form $\lambda w. [\text{Max}_{\inf}(Q,w) = p]$, for some $p \in Q$. Moreover, every cell in the partition of $A$ (as defined in (10)) will be identifiable (through exhaustification) by specifying the unique proposition of this form that satisfies the worlds in this cell.

(10) **The partition of context-set $A$ induced by $Q$.** Partition$_C(Q, A)$ – henceforth the Contextual Partition, is the set of equivalence classes of $A$ under the relation: $w \sim w'$ iff $\forall p \in Q [p(w) = p(w')]$

(11) If Dayal’s presupposition is met, Partition$_C(Q, A)$ can be re-written as

$$\{[Exh(Q,p)]_\Lambda: p \in Q\},$$

where $Exh(Q,p) = \lambda w. w \in p$ & $\forall q \in Q [w \in q \rightarrow p \subseteq q]$ = $\lambda w. \text{Max}_{\inf}(Q,w) = p$. 

and $\phi_A$ is the portion of $A$ that satisfies $\phi$, i.e., $A \cap \phi$.

(12) **Simple Solution to the problem in (8):** If $A$ is a context set that satisfies the presupposition of $Ans_D(Q)$, then every cell in Partition$_C(Q, A)$ is identifiable by a member of $Q$: 

$$\forall C \in \text{Partition}_C(Q, A) \ \exists p \in Q ([Exh(Q,p)]_\Lambda = C).$$

**Illustration:**

$Q = \{p, q\}$ where $p$ and $q$ are logically independent,

$A$ is a context set in which the presupposition of $Ans_D$ is met

$$\text{Partition}_C(Q, A) \subseteq \{[p \& \neg q]_\Lambda, [q \& \neg p]_\Lambda\} = \{[Exh(Q,p)]_\Lambda, [Exh(Q,q)]_\Lambda\}$$

So here is where we are. We have seen an arithmetic problem that arises when we focus on the Logical Partion of $Q$ (given in (3)). Specifically, we have seen that there will be many cases where we won’t be able to identify cells in that partition by a proposition in the question’s denotation. But we have also seen that things change when we move to talk about the Contextual Partition (given in (10)). If Dayal’s presupposition is met, there will never be more cells in that partition than propositions in the question’s denotation. Moreover, every cell in the partition will be derived when the context-set is updated by the exhaustification of a proposition in the question denotation (as we saw in (12)).

---

$^9$ Note that although an answer to a question must identify a cell by exhaustification, the answer to a question according to Dayal is not the cell itself, but rather the proposition that would identify the cell if exhaustified,
1.3. Evidence for Dayal’s Solution

As mentioned at the very beginning, two pieces of evidence have been presented in favor of Dayal’s presupposition. One, brought up by Dayal, comes from the inferences we draw from admissible questions and the other, presented in later work, comes from patterns of acceptability, in particular negative islands.

1.3.1. Inferences of admissible questions

Consider the interrogative constructions in (13). Dayal’s presupposition (together with certain assumptions about the meaning of the whP’s restrictor) derive (i) an existence presupposition for all the constructions in (13) (that at least one of a b and c came to the party) and (ii) a uniqueness presupposition for (13)a (that at most one of the three came). And these presuppositions are supported in that they account for inferences that speakers draw from these constructions.\(^\text{10}\)

\[
\begin{align*}
(13) \ a. & \text{ Which girl (among a, b and c) came to the party?} \\
b. & \text{ Who (among a, b and c) came to the party?} \\
c. & \text{ Which girls (among a, b and c) came to the party?}
\end{align*}
\]

To see how the presuppositions follow, consider first (13)a. The Hamblin set associated with the question is provided in (14). Since this set contains three logically independent propositions (corresponding to the three girls), it can have a maximally informative true member, only if exactly one of the three propositions is true.

\[
(14) \ Q = \{p_a, p_b, p_c\} (*\text{three logically independent propositions corresponding to the three girls}*)
\]

**Presupposition:** exactly one proposition among the three is true

(Eliminates five cells in the Logical Partition.)

\[
\text{Partition}_C(Q, A) \subseteq \{[p_a \& \neg p_b \& \neg p_c], [p_b \& \neg p_a \& \neg p_c], [p_c \& \neg p_a \& \neg p_b]\}
\]

Consider next (13)b,c, and their Hamblin denotation, Q, in (15). Q contains seven propositions corresponding to pluralities of the three girls. If there is no true proposition in the set, there, of course, no maximally informative true member, hence an existence presupposition is derived. However, nothing is predicted beyond this existence presupposition. If one of the propositions is true, the set is guaranteed to have a maximally

---

\(^{10}\) The existence inference is weaker in (13)b than in the other sentences. To account for this, we might assume that restrictor of the whP, who, can be true of what Bylinina and Nouwen (to appear) call the zero individual.

\(^{11}\) Equality (rather then the subset relation) does not hold for every context-set \(A\) that satisfies Dayal’s presupposition. If \(A\) satisfies Dayal’s presupposition, every \(w \in A\) is guaranteed to satisfy one of the exhaustified propositions: \(\text{Exh}(Q, p_a)\) or \(\text{Exh}(Q, p_b)\) or \(\text{Exh}(Q, p_c)\). Subsequently, \(\text{Partition}_C(Q, A)\) is guaranteed to be a subset of \(\{[\text{Exh}(Q, p_a)]_\Lambda, [\text{Exh}(Q, p_b)]_\Lambda, [\text{Exh}(Q, p_c)]_\Lambda\}\), but one of these three propositions could be a logical contradiction (If \(A\), for example, entails the negation of \(p_a\)). The alternative to Dayal’s presupposition that I will suggest in (20) will guarantee equality.

---
informative true member since the set is closed under conjunction \((p_x \oplus y \Leftrightarrow p_x \land p_y)\). Once again, this presupposition guarantees that the cells in the Contextual Partition are each identifiable by applying \(Exh\) to a member of the question denotation.

(15) Who/which girls (among a, b and c) came to the party?

\[
Q = \{p_a, p_b, p_c, p_{ab}, p_{ac}, p_{bc}, p_{abc}\}
\]

(*seven propositions corresponding to the plural individuals in the restrictor*)

**Presupposition**: one of the seven propositions is true.

(Eliminates one cell in the Logical Partition.)

\[
\text{Partition}_C(Q, A) \subseteq \{[p_a \& \neg p_b \& \neg p_c]_\Lambda, [p_b \& \neg p_a \& \neg p_c]_\Lambda, [p_c \& \neg p_a \& \neg p_b]_\Lambda,
\]
\[
[p_{ab} \& \neg p_c]_\Lambda, [p_{ac} \& \neg p_b]_\Lambda, [p_{bc} \& \neg p_a]_\Lambda,
\]
\[
[p_{abc}]_\Lambda
\]
\[
= \{[Exh(Q, p_a)]_\Lambda, [Exh(Q, p_b)]_\Lambda, [Exh(Q, p_c)]_\Lambda,
\]
\[
[Exh(Q, p_{ab})]_\Lambda, [Exh(Q, p_{ac})]_\Lambda, [Exh(Q, p_{bc})]_\Lambda,
\]
\[
[Exh(Q, p_{abc})]_\Lambda\}
\]

1.3.2. Inferences of admissible questions

Recent accounts of negative islands have agreed that Dayal’s presupposition is a necessary component in the explanation (Abrusán, 2007, 2014; Abrusán and Spector, 2011; Fox and Hackl, 2006; Schwarz and Shimoyama, 2011). Specifically, they all share the assumption that a negative island results from Maximality Failure (MF) – a question denotation that cannot possibly have a maximally informative true member, as demanded by Dayal’s presupposition. Consider the contrast in (16). (16)a is an ordinary degree question sensitive to negative Islands, as shown in (16)b. The fact that the island is ameliorated by the introduction of the modal *allowed* in (16)c has been taken to argue that MF is the source of unacceptability. (See Fox, 2007b for a discussion of why amelioration would follow under any MF account of the negative island.)

(16) a. Tell me how fast you drove.

b. *Tell me how fast you didn’t drive.

c. Tell me how fast you are not allowed to drive.

I will illustrate why this might be the case focusing on Fox and Hackl’s (2006) account. Under this account, degree domains are densely ordered, and consequently the denotations of all of the questions in (16) consist of infinite sets of propositions, densely ordered by entailment. In (16)b, but not in (16)a or (16)c, this leads to MF. The question in (16)a denotes the set of propositions in (17)a. This set, although densely ordered by entailment, will have a maximally informative true member, the proposition \(\lambda w. \text{Speed}(you, w) \geq d^*\) where \(d^*\) is the addressee’s actual speed of driving.

(17) Denotations of Questions in (16)

a. In (16)a, \(Q = \{\lambda w. \text{Speed}(you, w) \geq d: d \in \mathbb{D}_d\}\)

b. In (16)b, \(Q = \{\lambda w. \text{Speed}(you, w) < d: d \in \mathbb{D}_d\}\)

c. In (16)c, \(Q = \{\lambda w. \forall w' \in \text{MB}_w \text{ Speed}(you, w') < d: d \in \mathbb{D}_d\}\)
The question in (16)b, however, will never have a maximally informative true member. For any degree d higher than d*, the proposition $\lambda w. Speed(you,w) < d$ will be true, and the propositions will be more informative the smaller d is. Since there is no smallest degree greater than d* in the densely ordered domain of degrees, Dayal’s presupposition cannot be satisfied. The effect of the modal follows as well. For example, if the modal base entails the proposition

$\lambda w. Speed(you,w) < d$

but doesn’t entail anything beyond that, then $\lambda w. \forall w' \in MB_w Speed(you,w') < d'$ will, of course, be the most informative true proposition in the set. The logic is outlined in (18).

(18) Let $T(Q, @)$ be the set of true members of Q in world @ and $d^*_w$ be the addressee’s speed in w:
   a. In (16)a $T(Q, @) = \{\lambda w. Speed(you,w) \geq d : d \leq d^*_w\}$
      This set has a strongest member since \{d: d \leq d^*_w\} has a maximum
   b. In (16)b, $T(Q, @) = \{\lambda w. Speed(you,w) < d : d > d^*_w\}$
      This set has no strongest member because \{d: d > d^*_w\} has no minimum.
   c. In (16)c, $T(Q, @) = \{\lambda w. \forall w' \in MB_w Speed(you,w') < d : \forall w' \in MB_{w'}[d > d^*_w]\}$
      This set could have a strongest member because \{d: \forall w' \in MB_{w'}[d > d^*_w]\} could have a minimum.

And, once more, whenever it is presupposed that Q has a strongest true member, every cell in $\text{Partition}_C(Q,A)$ (where A is the context-set) will be identifiable using $Exh$.

1.4. Interim summary

In this introductory section we have seen two empirical arguments for Dayal’s presupposition, one coming from negative islands and the other from the inferences speakers draw from ordinary wh-questions. We also provided a possible conceptual motivation for the presupposition, namely that it eliminates an arithmetic problem we identified, stemming from our putative constraint requiring that a question be answerable by a single member of the question denotation. Specifically, we have seen in (12) that if Dayal’s presupposition is met, cell identification in (19) is met as well.

(19) **Cell Identification (CI):** A question Q and a context-set A meet Cell Identification if

$\forall C \in \text{Partition}_C(Q,A) \exists p \in Q \left( [Exh(Q,p)]_A = C \right)$

It is easy to see that the converse holds as well: if CI is met, so is Dayal’s presupposition (if $Exh$ receives the definition in (11)). In light of this equivalence, we might ask which is the basic requirement imposed by grammar. What I will suggest in this paper is that it is CI. This suggestion will be based on two different empirical considerations. The first, from negative islands, will motivate a strengthening of the requirement from questions, which will be very natural if CI is the basic condition (but will make less sense otherwise). Specifically, we will see reasons to think that it is not only true that every cell in the Contextual Partition must

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12 See Fox, 2010 where I propose a different constraint on questions. Evaluating the argument for CI based on negative islands will thus require some conceptual assessment.
be identifiable by a member of Q, but that the converse must also hold – every member of Q must identify a cell (Non-Vacuity, NV). These two requirements together yield the demand of Question Partition Matching:

(20)  **Question Partition Matching (QPM):** A question Q and a context-set A meet QPM if they meet CI and Non-Vacuity (NV)

    a. CI: \( \forall C \in \text{Partition}_C(Q,A) \exists p \in Q \left( [\text{Exh}(Q,p)]_A = C \right) \) and
    b. NV: \( \forall p \in Q \exists C \in \text{Partition}_C(Q,A) \left( [\text{Exh}(Q,p)]_A = C \right) \)

The second empirical argument will be based on MS, which is a counter-example to \( \text{Ans}_D \). We will see that it is not a counter-example to CI (or to the stronger QPM) if we move to a different theory of Exh, one which has been supported in the domain of Scalar Implicatures.\(^{13}\)

The remainder of the paper is organized as follows. In section 2, I will further explain the two challenges just mentioned for Dayal’s semantics, which in sections 3 and 4 will serve to argue for QPM. In sections 5 through 7 I will discuss various predictions that are made regarding the distribution of MS.

**2. Challenges for Dayal’s semantics**

2.1. Mention Some

According to Dayal the answer to a question, Q, is the most informative true member of Q (hence the presupposition). This answer entails all true members of Q and is thus never an MS answer.\(^{14}\) So, for example, \( \text{Ans}_D \) can deliver only one type of argument to the responsive predicates know and forget in (21) and this argument would derive the MA reading. The MS reading is simply not derivable. (If Mary knows just one among the many locations where we can get gas, she does not know a true member of the Hamblin denotation that entails all other true members.)

(21)  Mary knows where we can get gas in Cambridge.

    *mention some (MS)*
    
    Mary knows one location where we can get gas.

    *mention all (MA)*
    
    Mary knows all locations where we can get gas.

It is, thus, reasonable to conclude that \( \text{Ans}_D \) sometimes demands too much from a question.

---

\(^{13}\) As we will see in section 4, the second argument can also be accommodated without directly imposing CI. What is crucial, however, is that we revise \( \text{Ans}_D \), so that it makes explicit reference to Exh (and in particular, to a definition of Exh that can account for FC inferences).

\(^{14}\) It is equivalent to Weak Exhaustivity whenever Dayal’s presupposition is met.
2.2. Higher order quantification – a mysterious Negative Island (Spector, 2008)

Spector (2008) identified a new type of wh-question, which he analyzed as involving higher order quantification. He then showed that this type of question is sensitive to negative islands, a fact that does not follow from Dayal’s presupposition. Since the sensitivity to negative islands is so similar to what we see in cases that do follow from Dayal’s presupposition, this suggests that \(\textit{Ans}_D\) sometimes demands too little from a question.

2.2.1. Higher order quantification

Consider the sentences in (22). Under standard assumptions, whPs quantify over ordinary individuals – type \(e\). The predicted Hamblin denotation for both questions in (22) is, therefore, the set of propositions \(\{p \land \exists x \in R[p = \lambda w. \text{Required}_w(\lambda w'). \text{We read}_w x \text{ for this class}]\}\), where \(R\) is a subset of \(D_e\) (the denotation of the whPs restrictor).

\[(22)\]

a. What are we required to read for this class?
b. Which books are we required to read for this class?

A complete answer would then specify all the things in \(R\) we are required to read (as well as all of the things in \(R\) that we are not required to read). Imagine that no such things exist. By the standard assumptions, the answer would either be undefined (if \(\textit{Ans}_D\) is indeed an obligatory operator) or (if not) it might simply state that there is nothing that we are required to read.

With this in mind, Spector asks us to imagine a situation where, despite there being no particular thing we are required to read (no book, paper, reading material, etc.), there are still requirements pertaining to reading, for example, a situation where it is required that we either read all of the Russian books on the reading list or all of the French books and that the choice among these two options is left for us to make.

Now consider what would happen if we embed one of the questions in (22) under a responsive (veridical) predicate yielding a sentence of the form \(x \mathcal{V} \text{what we are required to read}\), as in (23). If standard assumptions hold, the resulting statement would either be a presupposition failure or the statement that Mary stands (at the relevant time) in the \(\mathcal{V}\) relation to the proposition that there is nothing we are required to read. It is not clear whether the sentences have this interpretation (a fact that might be attributed to Dayal’s presupposition). But the sentences definitely do have a different salient interpretation, one that is true just in case Mary stands in the \(\mathcal{V}\) relation to a proposition that expresses a disjunctive requirement.\(^{15}\) This does not follow from standard assumptions.

\[(23)\]

a. Mary knows/forgot what we are required to read.
b. Mary knows/forgot which books we are required to read.

---

\(^{15}\) As we will see in section 6, such an interpretation (higher-type) is not available with an English singular whP (e.g. \textit{which book}).
So what needs to change in order to derive this salient interpretation? Spector claims that the whP needs to quantify over objects of a higher type than simple individuals, specifically he suggests upward entailing generalized quantifiers. This suggestion can be implemented with the assumption that the restrictor of a whP, a set of individuals, R, can be shifted to a set of upward entailing generalized quantifiers over R (leaving a trace of the appropriate type).\(^16\)

\[(22)’\]

**Higher-Order Quantification:**

- **LF:** Wh shift (restrictor) \(\lambda w \cdot \{w \in R \mid w \text{ is a required Q}\}.)\(\text{PRO}\) to read x for this class?
- **Denotation:** \(\{p: \exists Q \in UGQ(R) \mid p = \lambda w. \text{Required}_w (\lambda w') Q\{x: \text{We read}_w x \text{ for this class}\}\}\),

Where UGQ(R) is the set of upward entailing generalized quantifiers that live on R.

With this in place, we can account for the attested interpretation. The answer to the question would have to specify which propositions in the denotation are true, and since the disjunction of (the Montague Lift of) two plural individuals in R is a generalized quantifier over R, the proposition that the disjunction is required will be in the question denotation. And, of course, Dayal’s presupposition would be satisfied.\(^17\)

### 2.2.2. Sensitivity to Negative Islands

Spector presents evidence from ellipsis that higher order quantification is real and sensitive to negative islands. Consider the question answer pairs in (24) and (25). The answers (all quantificational fragments) show an ambiguity that can be explained if higher order quantification is available along with standard quantification over individuals. If the wh trace ranges over simple individuals, the quantifier in the fragment answer will have scope over the modal *required*. If the trace ranges over generalized quantifier, the modal will have wide scope.\(^18\)

\[(24)\] What are you required to read for this class?
- [War and Peace or Brothers Karamazov. (Required>or; or >required)]

\[(25)\] Which books are you required to read for this class?
- a. The Russian books or the French books. (Required>or; or >required)
- b. Three Russian books. (required>3; 3 >required)
- c. [MB or SE] and [W&P or BK] (required>or; or >required)

---

\(^{16}\) The restriction to upward entailing quantifiers is needed to account for the fact that the answer to (22) need not specify prohibitions. For a possible way of deriving this restriction, see note 48.

\(^{17}\) To derive a non-trivial existence presupposition for (13) and (22), we would need to restrict or modify higher-type readings. The proposal made in section 3 would rule out a higher type readings for (13) but not for (22). To derive the presupposition that some requirement was made (in place for me at least in (22)b), one would need to remove the tautological GQ from the domain of quantification. This will be achieved if the type-shift rule is stated as in note 48.

\(^{18}\) Of course a full account of the connection between the representation of the question and of the fragment requires specific assumptions about the analysis of fragment answers. For concreteness, we can adopt the assumption that fragments involve ellipsis which must satisfy a Parallelism condition of the sort argued for in Rooth, 1992). This would probably require the assumption that whPs have a landing site above the subject and below the interrogative C (see Romero, 1998).
The unavailability of narrow scope for the quantifier in the fragment answer in (26) can be seen to demonstrate that the construction is sensitive to negative islands. This is further supported by the observation of modal obviation in (27), corresponding to what we’ve seen in (16)c.

(26) What did you not read for this class?
War and Peace or Brothers Karamazov. (*not>or; or >not)$^{19}$

(27) What are you not allowed to read for this class?
War and Peace or Brothers Karamazov. (not>or; or >not)

In the case of degree expressions, modal obviation provided support for the claim that Dayal’s presupposition is involved in the account. So one would hope that Dayal’s presupposition will provide an account here as well. But this is not the case. If you read everything but War and Peace and brothers Karamozov, the proposition that you didn’t read War and Peace or Brothers Karamzov (not>or) would be the most informative true member of the question denotation. Thus, Dayal’s presupposition would be satisfied with higher order quantification and we would expect the fragment answer in (26) to be acceptable on the not>or representation.$^{20}$

So here is where we are now. In 2.1. the MS interpretation of questions was taken to reveal an area where Ans$_D$ demands too much from a question. Here we see a place where it arguably demands too little. In the next two sections, I will propose a resolution for these two problems (of under- and over-generation), beginning with the latter. The resolution in both cases will be based on the idea that the relevant question presupposition stems from the problem of question duality discussed in section 1 – from the need to connect the question denotation to the partition it induces. The problem of over-generation will be resolved by strengthening CI and demanding that the mapping between questions and partitions meet NV as well, as in (20). The problem of under-generation will be resolved once we move to a more sophisticated theory of the mapping (between denotation and partition), namely a theory of exhaustivity that can account for free choice inferences.

---

$^{19}$ A way to see that not>or is ruled out is to track “ignorance inferences” – to observe the obligatory inference that the speaker does not know whether W&P was read (and likewise for BK). If not>or were possible, the fragment (when exhaustified) could provide a complete answer to the question, which would be associated with no ignorance inferences.

$^{20}$ One might suggest to rule out higher order quantification for (26) based on the observation that the resulting interpretation is not sufficiently distinct from the basic interpretation. Specifically, higher order quantification yields the same partition as the one induced by the more basic semantic type. This could account for the restriction along with an appropriately stated economy condition (along the lines of e.g., Reinhart, 1983 or Fox, 2000). But stating the economy condition so that it would still allow for higher order quantification in (21) is not trivial (see (33)). For an argument that higher order quantification is indeed available in (21) (independently of my account of MS) consider the availability of Free Choice in the fragment answer, which, on many accounts, requires can>or.

(i) Where can we get gas?
Either at the Shell station or the pump across the street. (Free choice available $\rightarrow$ can > or)
3. Over-generation and Question Partition Matching

As mentioned in section 1, Dayal’s presupposition is equivalent to the demand that every cell in the Contextual Partition be identifiable (via Exh, as defined in (11)) by a member of Q (CI). We will now see that the problem of over-generation exemplified by the unacceptability of not or in (26) is resolved the moment we add to CI the converse requirement of Non-Vacuity, yielding the requirement of QPM defined in (20) repeated below:

(20) Question Partition Matching (QPM): A question Q and a context-set A meet QPM if they meet CI and Non-Vacuity (NV)

a. CI: \( \forall C \in \text{Partition}_C(Q,A) \exists p \in Q (\lbrack \text{Exh}(Q,p) \rbrack_A = C) \) and

b. NV: \( \forall p \in Q \exists C \in \text{Partition}_C(Q,A) (\lbrack \text{Exh}(Q,p) \rbrack_A = C) \)

For not to outscope or in the fragment answer in (26) the antecedent question would require higher order quantification (as in (22)’ for (22)). In other words, the antecedent question in (26) would have to receive the LF representation and semantic denotation in (26)’:

(26)’ Higher-order quantification:
LF: Wh shift(restrictor) \( \lambda w. \text{Not } Q \lambda x. \text{we read } x \text{ for this class?} \)
Denotation: \{p: \exists Q \in \text{UGQ}(R) \ (p = \lambda w. \{x: \text{We read}_w x \text{ for this class}\} \not\in Q\}, \)
Where UGQ(R) is the set of upward entailing generalized quantifiers that live on R.

The question denotation is guaranteed to have a maximally informative true member, thus satisfying CI (equivalent, at the moment, to Dayal’s presupposition). However, it will not satisfy NV, at least if there are two or more objects in R. To see this, assume that \( b_1 \in R \) and \( b_2 \in R \). The conjunction of the (Montague-Lift) of the two will be a member of UGQ(R), and the proposition in (28) will be in the question denotation. Since this proposition is too weak to be the maximally informative true member of Q, there is no way for NV to be satisfied.

(28) \( \lambda w. \neg (\lbrack \text{We read}_w b_1 \text{ for this class} \rbrack \land \lbrack \text{We read}_w b_2 \text{ for this class} \rbrack) \)

A weak proposition of this sort (\( \neg > \lambda \)) will always be in the question denotation.23 And since such a proposition can never be a maximally informative true member, NV will never

21 This equivalence will break down in section 4.
22 Applying Exh, as defined (11), to this proposition will yield a contradiction. Note that nothing changes if we move to a theory of Exh that does not yield contradictions in cases of this sort (e.g. G&S 1994; Fox, 2007a, Bar-Lev and Fox, 2017). In all of these theories, Exh yields a meaning that is necessarily weaker than a cell in the partition.
23 An obvious question that could be raised at this stage is whether the question denotation can be contextually restricted (or pruned), by, e.g., a covert restrictor, C conjoined with the current restrictor of the whP (UGQ(R)∩C). The worry is that such contextual restriction could prune (28) [and all other propositions that lead to a violation of NV] from the question denotation leading to an acceptable result. (See Fox and Hackl, 2006 and subsequent work on negative islands where a very similar issue arises.) To rule this pruning out, I would like to appeal to constraints on pruning introduced in the context of work on exhaustivity (Bar-Lev, 2018; Cmiel et. al., 2015; Fox and Katzir, 2011; Katzir, 2014; Magri, 2009, 2011). For example, assume with Fox and Katzir, that a proposition p can be pruned from a set of propositions Q only if the resulting question [Q – {p}] makes p irrelevant. This constraint on pruning would rule-out pruning of (28) given that it is the disjunction of two non-pruned alternatives (and relevance, as it was defined in section 1, is closed under Boolean operators). See also notes 32 and 37.
be satisfied in this environment. The moment additional quantificational expressions are introduced above the \(wh\)-trace, as in (27), things will change (for certain Context-sets) for the reasons discussed in Fox, 2007b – generalizing observations in Fox and Hackl, 2006. For example, the corresponding proposition to (28) in the case of (27) will be the following:

\[
\lambda w. \neg \text{Allowed}_w ([\text{We read } b_1 \text{ for this class}] \land [\text{We read } b_2 \text{ for this class}])
\]

And this proposition can be the most informative true proposition in the Hamblin set associated with higher order quantification. So Question Partition Matching accounts for the negative island and its obviation by appropriately selected modals.

### 4. Under-generation and an alternative definition of \(Exh\)

The over-generation problem for Dayal’s proposal was resolved in the previous section by strengthening the presupposition associated with interrogative constructions. I suggested that such constructions are not just subject to Dayal’s maximality requirement. They are also subject to NV – the requirement that every proposition in the question denotation identify a cell in the Contextual Partition. Now I would like to argue that the problem of under-generation (MS) indicates that interrogative constructions are, in fact, not subject to maximality in the first place and that this requirement should be replaced with cell-identification, CI.

\(Ans_D\) takes a set of propositions, \(Q\), and a world, \(w\), as input and returns the maximally informative among the true propositions in the set. From this it follows, as we saw in 2.1., that the answer to a question provides all of the true “positive” information (i.e. is equivalent to “weak exhaustivity”, whenever defined). And this is why \(Ans_D\) yields MA in (21), repeated below, and cannot account for MS.

\[
(21) \quad \text{Mary knows where we can get gas in Cambridge.} \\
\text{mention some (MS)}
\]

---

24 I also predict no higher order quantification for simple questions such as \(what \ did \ you \ read?\), as opposed to \(what \ are \ we \ required \ to \ read?\) I haven’t figured out a way to test this prediction directly, though I should note that, on the one hand, it is supported by the existence presuppositions of the sentences in (Error! Bookmark not defined.) [but see note 17 and 25], and, on the other hand, it might be disconfirmed by the proposal in Elliott, Nicolae and Sauerland 2018.

25 As it stands, the proposal can’t be right. The contradictory GQ is an UE GQ living on \(R\), and the resulting proposition cannot be in the question denotation if QAP is a requirement. So we need to change the type shift rule. But the type shift rule needs to change on independent grounds, see section 6.1. The proposal made in footnote 48 would eliminate the problem.

26 Let \(Op\) be a universal modal. The relevant logical fact is that for every set of propositions \(Q\), and contingent proposition \(p \in Q\), it is possible for \(\lambda w.\text{Op}(w,p)\) to be the maximally informative true member in \(\{\lambda w.\text{Op}(w,q): q \in Q\}\).

27 The proposal made in this section is one of two proposals I considered in Fox 2013 and Fox 2015. The other proposal I entertained is incompatible with Dayal’s account of the presupposition of singular \(wh\) questions. See Xiang (2015) for relevant discussion.

28 To repeat, an answer to a question is the proposition that identifies the correct cell in the partition, but it is not the actual cell. If it were the cell, we would not have the argument from Heim that questions do not denote partitions directly – though the picture is more subtle if the proposals in Spector and Egré (2015) are adopted. See notes 39 and 40.
Mary knows one location where we can get gas.

**mention all (MA)**

Mary knows all locations where we can get gas.

The problem of under-generation suggests that Dayal’s maximality requirement is too demanding. But, shouldn’t it suggest the same for the requirement of CI? After all, haven’t we shown in 1.4. that the two requirements are equivalent? The answer is subtle. Equivalence holds but only if the proposed method of cell-identification relies on maximality (if the function from propositions to cells is \( \lambda p. \lambda w. [\text{Max}_{inf}(Q,w) = p]/_A \)). The method of cell identification that comes out of current work on scalar implicatures breaks the equivalence and, I would like to suggest, resolves the problem.

More specifically, I would like to suggest that the MS challenge stems from an incomplete theory of exhaustification.\(^{29}\) Once we move to a more accurate theory (based on considerations that come from the domain of scalar implicatures), we will see that the requirement of CI makes the right predictions. Specifically, we will see that there are cases where \( p \) can identify a cell by exhaustification, though \( p \) is not the most informative true member of \( Q \). These cases, if I am right, are precisely the cases where MS arises.

Assume that there are \( n \) relevant locations and let \( \check{\ll} l \) stand for the proposition that we can get gas in the \( i \)-th location (and \( l \) stand for the proposition that we do so). Assume that the correct cell in the partition induced by a question is the proposition that we can get gas in the first and second location and nowhere else (\( \check{\ll}l_1 \wedge \check{\ll}l_2 \wedge \neg \check{\ll}l_3 \wedge \cdots \neg \check{\ll}l_n \)).\(^{30}\) If CI must hold, this cell needs to be identified by a proposition in the question denotation via exhaustification. But if \( Exh \) is defined as in (11) above \([Exh(Q,p,w) \equiv [\text{Max}_{inf}(Q,w)=p]]\), only MA can be derived. So this, I would like to claim, is the source of the problem.

With a more sophisticated theory of exhaustification (one that accounts for the conjunctive interpretation of disjunction in certain modal contexts), we will see that the MS/MA ambiguity can be attributed to an ambiguity in the question denotation. In the case of MA, the question denotation will be such that one of its members will identify a cell only if it contains all the positive true information. (In our case \( \check{\ll}l_1 \wedge \check{\ll}l_2 \) will be the cell identifier.) In the case of MS, a cell-identifier can be a relatively weak proposition; in our case it will be the proposition \( \check{\ll}(l_1 \vee l_2) \) \( \equiv (\check{\ll}l_1 \vee \check{\ll}l_2) \). I will show that this can explain MS under a natural modification in the answer operator (in addition to the modification that automatically results from the alternative theory of \( Exh \)). Moreover we will see that the necessary ambiguity in the question denotation is already in place, given the observations made in section 3.

Though our overall goal is to replace Dayal’s presupposition with QPM (CI+NV), we can, nevertheless flesh out the argument made in this section using Dayal’s operator in (9), restated with \( Exh \) replacing \( \text{Max}_{inf} \) (as suggested in (11)).

\(^{29}\) This I share with Schulz and van Rooij (2006), though the theory of exhaustivity that I have is very different from theirs, as are the resulting predictions.

\(^{30}\) As we will see, the cells are identical for MS and MA only if we keep to context-sets in which you never (even in any of the allowed worlds) get gas in more than one location (something which will require pruning of propositions from the question denotation, if NV is to hold – see notes 23, 32 and 37).
(30) \[ \text{Ans}_D(Q) = \lambda w: \exists p \in Q[\text{Exh}(Q, p, w) = 1], \forall p \in Q[\text{Exh}(Q, p, w) = 1] \]

where \( \text{Exh}(Q, p, w) \Leftrightarrow [\text{Max}_{\text{inf}}(Q, w) = p] \)

Using this format, MS will suggest two modifications in Dayal’s proposal. The first is what I said above: the adjustment of the presuppositional restriction that follows the moment the \( \text{Max}_{\text{inf}} \) definition of \( \text{Exh} \) is replaced with one that derives the free choice interpretation of disjunction in modal contexts (FC), thereby explaining how \( \langle 1, v_1 \rangle \) can identify a cell. The second modification pertains just to the output of the function, which will now not be a proposition but a set of propositions (later to serve as the restrictor of an existential quantifier) – see George, 2011. This set will consist not just of the cell-identifier but of all true propositions in \( Q \) that entail the cell-identifier. With this, the MS/MA distinction will be determined by the cardinality of the set. (MS will arise if and only if the set is not a singleton – whenever \( Q \) has true members that asymmetrically entail the cell-identifier.)

We will start in 4.1. with some background on FC, introducing, in particular, the view of exhaustification argued for in Bar-Lev and Fox, 2017, 2018. We will then discuss (in 4.2.) the consequences of Spector’s assumptions (about higher order quantification, introduced in section 3) for the analysis of questions involving existential modals, such as that in (21). Finally (in 4.3.-4.5.), we will see how things can be put together to provide an account of the MS/MA ambiguity.

### 4.1. Background on Free Choice

Consider the sentence in (31) exemplifying FC. (31) involves a disjunctive sentence under the scope of an existential modal.\(^{31}\) As argued by Alonso Ovalle (2006) [building on Kratzer and Shimoyama 2002] the basic meaning of the construction is equivalent to matrix disjunction [just as in standard modal logic: \( \langle C \vee IC \rangle \) is equivalent to \( \langle C \rangle \vee \langle IC \rangle \). If this is the case, the basic meaning needs to be strengthened to entail matrix conjunction, \( \langle C \& IC \rangle \). I will assume that the method of strengthening involves the covert operator \( \text{Exh} \) that yields standard scalar implicatures, as proposed in Fox, 2007a and further defended in Crnič, 2016; Bar-Lev, 2018; and Bar-Lev and Fox, 2017, henceforth B&F.

(31) **Free Choice:**

You are allowed to have cake or ice cream.

\( \text{Exh}(Q)(\langle C \vee IC \rangle) = \langle C \& IC \& [\neg (C \& IC)] \)

[where \( Q = \{\langle C \vee IC \rangle, \langle C \rangle, \langle IC \rangle, \langle C \& IC \rangle\} \)\(^{32}\)]

---

\(^{31}\) For evidence that this is indeed the syntactic scope and various approaches to counter-evidence, see Bar-Lev, 2018.

\(^{32}\) To account for the optionality of the inference \( \neg \langle C \& IC \rangle \) it is natural to appeal to the pruning of alternatives – the inference disappears if the alternative \( \langle C \& IC \rangle \) is considered to be irrelevant hence pruned from \( Q \) (but see Fox, 2007a for a different account). Such pruning is consistent with the constraint argued for by Fox and Katzir, 2011 – a constraint crucial for understanding the impossibility of a conjunctive inference when the set of formal alternatives is closed under conjunction. See also note 23, as well as Chierchia, 2013; Katzir, 2014; Crnič et. al., 2015; and Singh et. al., 2016.
In Fox (2007), a single occurrence of Exh could not yield the conjunctive result. Instead Exh needed to apply recursively till it reached a fixed point. Here I would like to adopt the alternative view of exhaustification proposed by B&F, which takes cell-identification to be its defining property and is thus conceptually more in line with the proposal made here. (See Fox, 2013, 2015 where a third definition of Exh is pursued to account for MS.) Specifically, Exh takes a question, Q, and a proposition, p, and identifies a cell in the partition induced by Q (i.e. assigns a truth value to every member of Q). This is done as follows. First the truth-value 0 is assigned to all of the innocently-excludable propositions (as in Fox 2007a) and then the remaining propositions are assigned the truth-value 1:

(32) **Exhaustivity as Cell Identification** (Simplification of Bar-Lev and Fox (2017))

\[ \text{Exh}(Q,p,w) = 1 \text{ iff } \forall q \in Q[q \in \text{IE}(Q,p) \rightarrow q(w) = 0] \land \forall q \in Q[q \notin \text{IE}(Q,p) \rightarrow q(w) = 1]. \]

Where \( \text{IE}(Q,p) \) is defined as in Fox, 2007a to be the intersection of all maximal consistent exclusions (that is \( \text{IE}(Q,p) = \bigcap \{ A : A \text{ is a maximal subset of } Q, \text{such that } \{ p \} \cup \{ \neg q : q \in A \} \text{ is a consistent set of propositions} \} ) \). It is easy to see that this yields the result in (31). The only member of \( \text{IE}(Q, \langle C \lor IC \rangle) \) is the conjunctive alternative \( \langle C \& IC \rangle \). This alternative is assigned the truth-value 0 and all other members of Q are assigned the truth-value 1.

4.2. Spector’s ambiguity

Consider the interrogative complement of the responsive predicate *know* in (21). By Spector’s assumptions introduced in section 3, this construction can be associated with the two LFs in (21)’.

(21)’ **LFs for the complement of know in (21)**

a. **Low-Type Trace (distributivity applying above can)**

Wh restrictor \( \lambda x. \text{C}_{\text{int}} [x \text{ dist } \lambda y. \text{can we get gas in } y] \)

**Denotation:** \( \{ p : \exists X \in L [p = \lambda w. \forall y \in \text{ATOM}(X) \text{ Can}_{w'}(\lambda w'. \text{q get}_{w'} \text{ gas in } y)] \} \)

b. **High-Type Trace**

Wh shift(restrictor) \( \lambda Q_{\text{setL}} \text{can } Q \lambda x. \text{we get gas in } x \)

**Denotation:** \( \{ p : \exists Q \in \text{UGQ}(L) [p = \lambda w. \text{Can}_{w}(\lambda w'. \text{Q(\{x: \text{we get}_{w'} \text{ gas in } x\})})] \} \)

The procedure is more sophisticated in B&F (relying on *innocent inclusion*). As B&F discuss, the definition in (32) is equivalent to B&F’s whenever applying (32) yields a non-contradictory proposition. The use of (32) is innocent in the context of this paper: If (32) yields a contradiction for a member of Q, (32) and B&F’s operator are not equivalent, but they both yield a result that violates NV (see note 22).

Dist is a covert distribute operator that can combine with an individual and return a universal quantifier over the atomic parts of this individual (as in, e.g. Heim, Lasink and May, 1991). There are other possible representations that I am not discussing, e.g. a version of (21)’a in which dist is introduced below the modal. See Fox (2013) for discussion.
The restrictor of the wh-phrase in (21)'a denotes a set of locations, \(L\). Assume that there are three locations in \(L\) (\(\Lambda_1, \Lambda_2\) and \(\Lambda_3\)) and keep to the shorthand introduced earlier (\(l_i\) stands for the proposition that we get gas at \(\Lambda_i\)). The denotation of (21)'a will then contain the following propositions (parallel to the basic case in (15)):\(^{35}\)

\[(21)'a \text{ Low-Type Trace denotation of (21) when there are three locations in } L\]

The closure under conjunction of

\[
\{\lambda w. \text{Can}_w(\lambda w'. \text{we get}_w \text{ gas in } \Lambda_1), \lambda w. \text{Can}_w(\lambda w'. \text{we get}_w \text{ gas in } \Lambda_2), \lambda w. \text{Can}_w(\lambda w'. \text{we get}_w \text{ gas in } \Lambda_3)\}
\]

i.e.:

\[
\{ \langle l_1 \wedge l_2 \wedge l_3 \rangle, \langle l_1 \wedge l_3 \rangle, \langle l_2 \wedge l_3 \rangle, \langle l_1 \rangle, \langle l_2 \rangle, \langle l_3 \rangle \}^{36}
\]

The denotation of (21)'b will contain propositions that you get by introducing quantifiers within the scope of the existential modal – UE quantifiers that live-on \(L\). All such quantifiers can be written as disjunction of conjunctions (of the Montague-Lift) of the individuals in \(L\). Imagine that we “prune” from this set all propositions involving non-trivial conjunctions (conjunctions of more than one conjunct).\(^{37}\) With such pruning we would get the following question denotation:

\[(21)'b \text{ High-Type Trace denotation of (21) when there are three locations in } L\]

\[
\{\langle l_1 \rangle, \langle l_2 \rangle, \langle l_3 \rangle, \langle (l_1 \vee l_2) \rangle, \langle (l_1 \vee l_3) \rangle, \langle (l_2 \vee l_3) \rangle, \langle (l_1 \vee l_2 \vee l_3) \rangle\}
\]

4.3. The identified cells

The two sets of propositions [(21)'a and (21)'b] induce the same Logical Partition. Both sets contain \(\langle l_1 \rangle, \langle l_2 \rangle, \text{ and } \langle l_3 \rangle\), as well as a few propositions that can be derived by Boolean combinations of these three propositions. In other words, every cell in the partition is characterized by specifying truth-values for \(\langle l_1 \rangle, \langle l_2 \rangle, \text{ and } \langle l_3 \rangle\), which, in turn, determine the truth-values of the remaining members of either set:

---

\(^{35}\) For example, \(\langle l_1 \wedge l_2 \rangle\) is the proposition \(\lambda w. \forall y \in \text{ATOM}(l_1 \oplus l_2) \text{ Can}_w(\lambda w'. \text{we get}_w \text{ gas in } y)\).

\(^{36}\) Closure under conjunction comes from Dayal’s assumption that number neutral whP restrictors are closed under sum-formation together with the assumption that distributivity can apply above the existential modal. See Fox, 2013 for another possible account of MS (and its ultimate rejection), one which relies on low scope for the distributivity operator.

\(^{37}\) This pruning satisfies the constraints introduced in note 23 (see also note 32). Pruning of \(\langle (l_1 \wedge l_3) \rangle\) is crucial for satisfying NV whenever every world in the context-set falsifies \(\langle l_1 \wedge l_3 \rangle\). Cases where pruning does not take place will not affect our results, but they will be harder to go over. I will have to leave the exercise to the interested reader.
\[(33)\] \(\text{Partition}_{\text{L}}[\text{21}''\text{a}] = \text{Partition}_{\text{L}}[\text{21}''\text{b}] = \{\neg\square l_1 \land \neg\square l_2 \land \neg\square l_3, \ \square l_1 \land \neg\square l_2 \land \neg\square l_3, \ \square l_2 \land \neg\square l_1 \land \neg\square l_3, \ \square l_3 \land \neg\square l_1 \land \neg\square l_2, \ldots\} \]

Moreover, \(Exh\), as defined in (32), will identify each of the cells for both \((21)''\text{a}\) and \((21)''\text{b}\), except for the one in which \(\square l_1, \ \square l_2,\) and \(\square l_3\) are all false (except for \(\neg\square l_1 \land \neg\square l_2 \land \neg\square l_3\)), but see note 10:

\[(34)\]
\[\begin{align*}
\text{a. } & \lambda w. \text{Exh}([21)''\text{a}], \langle l_1, w \rangle) = \lambda w. \text{Exh}([21)''\text{b}], \langle l_1, w \rangle) = \neg\square l_1 \land \neg\square l_2 \land \neg\square l_3 \\
\text{b. } & \lambda w. \text{Exh}([21)''\text{a}], \langle l_2, w \rangle) = \lambda w. \text{Exh}([21)''\text{b}], \langle l_2, w \rangle) = \square l_2 \land \neg\square l_1 \land \neg\square l_3 \\
\text{c. } & \lambda w. \text{Exh}([21)''\text{a}], \langle l_3, w \rangle) = \lambda w. \text{Exh}([21)''\text{b}], \langle l_3, w \rangle) = \square l_3 \land \neg\square l_1 \land \neg\square l_2 \\
\text{d. } & \lambda w. \text{Exh}([21)''\text{a}], \langle l_1 \land \lambda l_2, w \rangle) = \lambda w. \text{Exh}([21)''\text{b}], \langle l_1 \land \lambda l_2, w \rangle) = \square l_1 \land \lambda l_2 \land \neg\square l_3 \\
\text{e. } & \lambda w. \text{Exh}([21)''\text{a}], \langle l_1 \land \lambda l_3, w \rangle) = \lambda w. \text{Exh}([21)''\text{b}], \langle l_1 \land \lambda l_3, w \rangle) = \square l_1 \land \lambda l_3 \land \neg\square l_2 \\
\text{f. } & \lambda w. \text{Exh}([21)''\text{a}], \langle l_2 \land \lambda l_3, w \rangle) = \lambda w. \text{Exh}([21)''\text{b}], \langle l_2 \land \lambda l_3, w \rangle) = \square l_2 \land \lambda l_3 \land \neg\square l_1 \\
\text{g. } & \lambda w. \text{Exh}([21)''\text{a}], \langle l_1 \land \lambda l_2 \land \lambda l_3, w \rangle) = \lambda w. \text{Exh}([21)''\text{b}], \langle l_1 \land \lambda l_2 \land \lambda l_3, w \rangle) = \square l_1 \land \lambda l_2 \land \lambda l_3 \\
\end{align*}\]

The first three cells are identified in the same way for the two questions: by application of \(Exh\) to one of the propositions \(\langle l_1\), \(\langle l_2\), and \(\langle l_3\) — the weakest propositions in \((21)''\text{a}\) and the strongest propositions in \((21)''\text{b}\). The other cells are identified by different propositions for the two questions, and, this, I claim is the source of the MS/MA distinction. If there is more than one location where one can get gas, the proposition that will identify the cell (when \(Exh\) applies to it) will mention all locations where one can get gas in the case of \((21)''\text{a}\) [leading to an MA interpretation], and will not do so in the case of \((21)''\text{b}\) [leading to MS].

4.4. Answer returns a set of propositions

Dayal’s answer operator was stated in (30) as one that takes a set of propositions and returns the cell identifier if one exists (undefined otherwise). But the cell identifier under (30) is the maximally informative true member of the question denotation, and this, as already mentioned many times, will always derive MA (or presupposition failure). So our first modification, as mentioned, is to move to the B&F definition of \(Exh\) in (32). Our second modification will be to have the Answer operator return not just the cell identifier but the set of true propositions that entail this cell identifier:

\[(35)\] \(\text{Ans}(Q) = \lambda w. \exists p \subseteq Q[\text{Exh}(Q, p, w) = 1]. \{q \subseteq Q: w \in q \land q \in (\lambda p \subseteq Q[\text{Exh}(Q, p, w) = 1])\}\)

Suppose that in \(w\) we can get gas at the first and second locations and nowhere else. We saw in (34)d that the cell-identifiers in the case \((21)''\text{a}\) and \((21)''\text{b}\) are different: it is the proposition \(\langle l_1 \land \lambda l_2\) in the case of \((21)''\text{a}\) and \(\langle l_1 \land v l_2\) in the case of \((21)''\text{b}\). Since every true proposition in \((21)''\text{a}\) is entailed by \(\langle l_1 \land \lambda l_2\), the result of applying \(\text{Ans}(w)\) to \((21)''\text{a}\) is a singleton proposition — \(\{\langle l_1 \land \lambda l_2\}\). The situation in \((21)''\text{b}\) is very different. Applying \(\text{Ans}(w)\) to this higher-type question yields three propositions \(\{\langle l_1\}, \langle l_2\}, \langle l_1 \land v l_2\}\). This distinction, I claim, underlies the MS/MA ambiguity.
4.5. Existential quantification over the Ans-set

In (21) (repeated below) the responsive predicate know takes a question as complement. I assume that the responsive predicate needs a propositional argument and that this leads to type mismatch: when Ans applies to the question it returns a set of propositions, which is not of the appropriate type.

(21) Mary knows where we can get gas in Cambridge.

I assume that this type mismatch is resolved when a covert existential quantifier is combined with the interrogative construction and the resulting constituent QRs as in (21)"\(^{38}\):

(21)" \[\exists[\text{Ans}[\text{where we can get gas}]] \lambda p. \text{Mary knows } p.\]

Given the ambiguity of the question where we can get gas, there will be two possible readings for (21). Assume that the actual world belongs to the cell in (34)d. If the embedded question receives the low-type interpretation in (21)"\(^{a}\), the output of Ans would be the singleton \{\{l_1 \land l_2\}\}. The sentence would then receive the MA interpretation stating that Mary knows this conjunctive proposition. But if the embedded question receives the high-type interpretation in (21)"\(^{b}\), the output of Ans would be a set of three propositions \{\{l_1\}, \{l_2\}, \{l_1 \lor l_2\}\}, in which case the sentence would assert that Mary knows one of these propositions – the MS reading.\(^{39}\) This account can extend to matrix questions if we assume that an addressee can freely choose among members of the Ans set (the output Ans). Or alternatively, we can assume that there are covert performative operators [imperative, cause and know], with the following LF (see, e.g., Hirsch 2017 and Sauerland and Yatsushiro 2017):

\[\llbracket \text{Ans-strong} \rrbracket = \lambda Q. \lambda w. \{p \in \llbracket \text{Ans} \rrbracket(Q)(w') : p \in \llbracket \text{Ans} \rrbracket(Q)(w)\}\]

This suggestion requires a longer discussion than can be had in this context. On the one hand, there might be independent reasons to assume Ans-strong: as pointed out by Spector and Egré 2015, it might be needed for a uniform statement of how responsive predicates take their Q arguments [both veridical and non-veridical]; and, Spector and Egré (2015) have proposed to deal with Heim’s original argument against universal use of Ans-strong by claiming that both Ans-strong and Ans-weak are used simultaneously. On the other hand, Klinedinst and Rothschild, 2011 and subsequent work have presented evidence that is problematic for Spector and Egré. I will have to leave this as an open question, but see Spector, 2018 for a defense of Ans-strong in light of counter-evidence. There are other possible fixes: with van Rooij (2003) and Schulz and van Rooij (2006), we could add the demand that members of the Ans-set have maximum utility (given a contextually given practical problem). Or we can simply prune all non maximal (i.e. strongest) members from the answer set:

\[\llbracket \text{Ans'} \rrbracket = \lambda Q. \lambda w. \exists p \in Q \{\text{Exh}(Q,p,w) = 1\}. \{p : p \in \llbracket \text{Ans} \rrbracket(Q)(w) \land \neg \exists q \in \llbracket \text{Ans} \rrbracket(Q)(w) \land q \subset p\}\]

---

\(^{38}\) It is critical to block a representation in which Ans is absent, e.g.: \[\exists[\text{where we can get gas}] \lambda p. \text{Mary knows } p.\]

One possibility is to assume that the only way to derive a question (without type-mismatch) is by base generating the Ans operator in the argument position of interrogative C (an identity relation among propositions) and QR-ing Ans to its scope position. Thanks to Wataru Uegaki for pressing me on this issue.

\(^{39}\) This, at the moment, seems too weak. As things stand, the MS reading will be true if Mary just knows the disjunctive cell identifier (\{l_1 \lor l_2\}) – without knowing that it is a cell-identifier. If Mary knows that in at least one of two locations gas is available, and in fact gas is available in both of the locations, we do not want (21) to come out true, not even on an MS reading. In Fox (2013) I suggested we deal with this by appeal to a stronger notion of Answerhood [leading to the requirement that Mary not just know a member of the Ans-set, p, but also know that p is a member of the Ans-set, see Heim, 1994 and George, 2011].

(i) \[\llbracket \text{Ans-strong} \rrbracket = \lambda Q. \lambda w. \{p \in \llbracket \text{Ans} \rrbracket(Q)(w') : p \in \llbracket \text{Ans} \rrbracket(Q)(w)\}\]

This suggestion requires a longer discussion than can be had in this context. On the one hand, there might be independent reasons to assume Ans-strong: as pointed out by Spector and Egré 2015, it might be needed for a uniform statement of how responsive predicates take their Q arguments [both veridical and non-veridical]; and, Spector and Egré (2015) have proposed to deal with Heim’s original argument against universal use of Ans-strong by claiming that both Ans-strong and Ans-weak are used simultaneously. On the other hand, Klinedinst and Rothschild, 2011 and subsequent work have presented evidence that is problematic for Spector and Egré. I will have to leave this as an open question, but see Spector, 2018 for a defense of Ans-strong in light of counter-evidence. There are other possible fixes: with van Rooij (2003) and Schulz and van Rooij (2006), we could add the demand that members of the Ans-set have maximum utility (given a contextually given practical problem). Or we can simply prune all non maximal (i.e. strongest) members from the answer set:

(ii) \[\llbracket \text{Ans'} \rrbracket = \lambda Q. \lambda w. \exists p \in Q \{\text{Exh}(Q,p,w) = 1\}. \{p : p \in \llbracket \text{Ans} \rrbracket(Q)(w) \land \neg \exists q \in \llbracket \text{Ans} \rrbracket(Q)(w) \land q \subset p\}\]
Making it the case that there is a member of the answer set, \( p \), such that I know \( p \).

4.6. Back to Question Duality

In this section we have seen that two modifications in \( Ans_D \) provide an account for MS when coupled with Spector’s proposal of higher order quantification. In the next sections, I will try to investigate various predictions made by this account. But first I would like to explain how the modification of \( Ans_D \) fits into the conception I outlined in sections 1 and 2. The main point is that our restatement of \( Ans_D \) is based on the idea that answers to a question in a world \( w \) are defined based on the proposition that identifies the cell to which \( w \) belongs (in the partition induced by the question). When this proposition is weaker than other members of the Hamblin set, we get MS; when it is the maximally informative true member, we get MA. Though the method of cell identification is different from that assumed by Dayal, we share with her a presupposition that guarantees CI.

In fact it would once again be equivalent to CI. And, as before, CI can be stated directly allowing us to accommodate the proposal in section 3. Specifically, \( Ans \) as defined in (35) could be restated as an operator that takes an information state, \( I \), (the context set with veridical predicates) and a world, \( w \), and demands that QPM be met.

\[
\text{Ans}(Q) = \lambda I : \text{QPM}(Q, I). \lambda w. \{ q \in Q : w \in q \land q \subseteq (\exists p \in Q)(\text{Exh}(Q, p, w) = 1) \}
\]

where (QPM(Q, I) holds iff

- CI: \( \forall C \in \text{Partition}_C(Q, A) \exists p \in Q ([\text{Exh}(Q, p)]_A = C) \)
- NV: \( \forall p \in Q \exists C \in \text{Partition}_C(Q, A) ([\text{Exh}(Q, p)]_A = C) \)

Or equivalently, as pointed out to me by Roger Schwartzchild, we can dispense with Partition_C and assume that partitions are derived by point-wise exhaustification:

\[
\text{Ans}(Q) = \lambda I : \text{Partition}(Q, I). \lambda w. \{ q \in Q : w \in q \land q \subseteq (\exists p \in Q)(\text{Exh}(Q, p, w) = 1) \}
\]

where (Partition(Q, I) holds iff point wise exhaustification of \( Q \) is a partition of \( I \). I.e., iff \( \{ \text{Exh}_Q(p) \} : p \in Q \} \) partitions \( I \).

5. Is an existential quantifier necessary?

Under the proposal made in section 4, MS is only possible when the cell identifier for \( Q \) is weaker than other true propositions in \( Q \), which is, in turn, only possible when an existential operators c-command the trace of \( wh \)-movement. Is this particular consequence correct? At first sight, it might seem to be, as the required operator is present in canonical examples of MS, such as (21). However, the empirical picture is far from clear. While various authors have argued that existential operators are required for MS (Chierchia and Caponigro, 2013; George, 2011 chapter 6; Fox, 2013; Xiang 2016), others have claimed that the governing factor pertains to pragmatic considerations to which we return in section 7 (Groenendijk and 40 To deal with non-veridical predicates, we can assume with Spector and Egré (2015) that there is existential quantification over \( I \) and \( w \), which will require a stronger notion of answerhood. See note 39.

41 This is the FC environment – where \( Q \) is closed under conjunction but not under disjunction.
Stokhof, 1984; Scholz and van Rooij, 2006; van Rooij, 2003, 2017). See Dayal, 2016 for some discussion.

Consider the questions in (39) and (40), all of which can receive an MS interpretation. The two questions in (39), like (21), both have an existential operator in the required position. But this is not obviously the case for the questions in (40).

(39) a. Where can I buy an Italian newspaper?  
   b. How can I get to the Station?  
   (van Rooij, 2017)

(40) a. Who has a light?  
   b. Who, for example, supported the bill?  
   (Beck and Rullmann, 2009)

Nevertheless, it might be possible to argue that an existential operator is present in an appropriate position, despite initial appearances: in (40)a the verb has (which shows a definiteness effect) has been famously analyzed as involving existential quantification (Freeze, 1992), and in (40)b the phrase for example, can be analyzed as an existential quantifier. (Consider John is an example of a senator that supported the bill). Such analyses would not be implausible, as all of the questions show the FC effect: in all of them a disjunctive answer can be understood conjunctively, the crucial ingredient for MS, under the account advocated here.\(^\text{42}\)

(41) a. Where can I buy an Italian newspaper?  
   Either at store A or at store B.  
   b. How can I get to the Station?  
   Either by following John or by following Mary.

(42) a. Who has a light?  
   Either John or Mary  
   b. Who, for example, supported this bill?  
   ?McCain or Kennedy (are examples of senators who supported the bill)

However, there are cases of MS where existential quantification is clearly absent. Consider the following examples suggested to me by Floris Roelofson:

(43) a. Who is going to the party (by car)?  
   b. Mary knows who is going to the party.

When the appropriate pragmatic conditions are met, e.g. when people are trying to figure out how to get to a party, the questions in (43) can receive an MS interpretation. And here no

\(^{42}\) The judgment in the case of (42)b is less clear to me than in the other examples. Still I think that a conjunctive interpretation is possible, as is perhaps clearer the following:

i. McCain OR Kennedy. They are the best examples I can think of.  
   ii. Either McCain or Kennedy is a good example.

In any event there will be clear cases where MS is present without existential quantification, so, at the end of the day, it might not be so important to figure out what happens in this particular case.
existential operator c-commands the trace and I don’t think a disjunctive fragment answer can be interpreted conjunctively. This looks like a problem.

What I would like to suggest is that the MS interpretation in this case has a different explanation. The question, I suggest, receives an MA interpretation with covert domain restriction. Such domain restriction can lead to an MS illusion, as in Schwarzschild’s (2000) analysis of the scope illusion that arises when existentials are embedded inside an island – singleton indefinites (see discussion in von Fintel, 2000). For example, the question in (43) might be interpreted as a request to specify all of the people going to the party whose plans the addressee is aware of (who among the people whose plans for the party you know is going?).

While I am not in a position to develop a full argument here, I think that the contrast in (44) might be taken to support this line of approach.

(44) a. Everyone here knows where we/one can get gas.
    b. Everyone here knows how we/one can get to the party.
    c. Everyone here knows who is going to the party.

The (a) and (b) sentences in (44) can receive an MS interpretation consistent with everyone knowing a different answer to the question: everyone here knows some place – potentially a different place – where we can get gas (or a different way of getting to the party). This is not the case, I think, for the sentence in (44)c. If this sentence receives an MS interpretation at all, it involves what we might call uniform MS, where what everyone knows is the same thing. This contrast would follow if the route to MS in (44)c involves domain restriction and if it is somewhat difficult in this case to come up with a domain restrictor that includes a variable bound by the matrix subject. If this is correct, we might be able to conclude that MS requires an existential operator c-commanding the trace of wh-movement.

To see if this line of reasoning is correct, it would be very useful to find ways of controlling for domain restriction. Since I don’t quite know how to do this, all I can offer in support of my conjecture at this stage are minimal pairs such as those in (44) [and the corresponding contrast in note 44], hoping that their account is based on difficulties associated with the complexity of the necessary domain restriction. Here’s another minimal pair. Suppose that there was no gas in the greater Boston area for a couple of days (say… the aftermath of a

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43 If whPs are existential quantifiers (as in Karttunen, 1977), we should expect to find similar illusive domain restriction to arise here. Specor (2018) claims that weak-exhaustivity is also an illusion arising from domain restriction.
44 Here is a similar contrast which supports the same conclusion. Suppose you find two people arguing about where to go get gas. (i) sounds like a natural way to stop the argument. But (ii) would not be a reasonable way to break the analogous argument about who to take a ride with (as opposed to (iii) which again contains a modal).
    (i) Why are you arguing? You actually both know where one can get gas.
    (ii) Why are you arguing? You actually both know who is going to the party.
    (iii) Why are you arguing? You actually both know how one can get to the party.

45 Thanks to Irene Heim for help in thinking through this example.
46 This is an example from Fox, 2013 inspired by the discussion in George, 2011.
storm). Suppose Josh got a huge tank truck and delivered gas to various gas stations (so that people like us can get gas).

When I asked people to imagine that all of this is part of the common ground, they reported different judgments for the questions in (45). These questions, in such a context, should be asking for exactly the same information, as it is contextually given that the places where one can get gas are precisely those places where Josh delivered gas. Nevertheless, MS is harder to get in (45)b. The contrast is stronger, I think, in (46) if we focus on situations where everyone knows different MS answers (differential MS). If, for some reason, the necessary implicit domain restriction is even more difficult in these cases, the contrast would follow from the proposal made in this paper.

(45) a. Mary knows where we can get gas. (MS, MA)
    b. Mary knows where Josh delivered gas. (?MS, MA)

(46) a. Luckily everyone knows where one can get gas. (MS, MA)
    b. Luckily everyone knows where Josh delivered gas. (*MS, MA)

6. Constraints on higher types

To get MS, under the proposal made here, wh-motion must cross an existential quantifier. But this is not a sufficient condition. It is also necessary for a trace in the scope of the existential quantifier to be interpreted as a higher-type variable (ranging over GQs). If there are environments where such an interpretation is not available, we expect MS to be unavailable as well.

6.1. Singular wh phrases

(47) and (48) below contrast in the availability of the interpretation identified by Spector.

(47) a. What are you required to read for this class? War and Peace or Brothers Karamazov. (Required>or; or >required)
    b. Which books are you required to read for this class? The Russian books or the French books. (Required>or; or >required)

(48) Which book are you required to read for this class? War and Peace or Brothers Karamazov. (*Required>or; or >required)

This contrast can be taken to argue that singular wh-phrases cannot quantify over higher-type traces. Why this should be the case is not critical for current purposes. What is important is that it leads to an expectation in the domain of MS. Specifically, we expect MS to be absent for singular whPs (as long as we can control for domain restriction).

47 Floris Roelofson (p.c.) notes that although the two questions are contextually equivalent, the difference in their form might make different practical problems salient. I do not know how to deal with this confound.
Suppose that a department chair, Sue, is required to form a committee with three professors as members, one of them serving as chair. To meet the pragmatic conditions (which we will be touching on in the next section) assume that Sue thinks the committee is not particularly important and that she would be willing to appoint anyone who is available to serve. In such a context, (49)a can receive an MS reading and (49)b cannot, or at least not easily (a contrast which is perhaps sharper if we insist on differential MS in (50), as in (44) and (46) and the examples in note 44).

(49)  a. Sue knows who can serve on this committee. (MS, MA)
b. Sue knows which professor can chair this committee. (?MS, uniqueness)

(50)  a. (Why are you arguing?) You both know who can serve on this committee. (Differential MS possible for some speakers)
b. (Why are you arguing?) You both know which professor can chair this committee. (Differential MS impossible)

If these contrasts are real, they can serve to argue that higher order quantification is necessary for true MS, as predicted by our proposal (with illusory MS slipping in by domain restriction, e.g. which professor that she asked...).

The argument would of course be better understood if we could explain the constraint on higher-order quantification. While I cannot do much here, I can provide further reasons to believe that the constraint is real. Consider the sentences in (51) and imagine that there is no particular book that Sue is required to read. Under such circumstances, the sentences would be unacceptable as expected given the existence presupposition of the definite article. What is important for my purposes is that this holds even if there is a disjunctive reading requirements, e.g. if Sue is required to read one of two books (of her own choice), say either W&P or BK.

(51)  a. Mary is required to read the book Sue is.
b. The book that Sue is required to read can be read in one week.
   Deviant if Sue is required to read [W&P or BK] (required>or) and nothing else.

Now consider the sentences in (52) and (53). These sentences are no longer deviant when only a disjunctive requirement holds, something that is mysterious if the trace of wh-movement is interpreted as a variable ranging over individuals – given the existence presupposition associated with free relatives and plural definite descriptions. However, it is explained if the variables can range over GQs with the disjunction satisfying the presupposition (see von Fintel, Fox and Iatridou, 2014 to understand how a maximality presupposition would be satisfied).

48 One possibility is that the mechanism that allows for higher order quantification, the necessary type shift rule, S (or the morpheme that converts the restrictor of the whP), takes a predicate A of individuals and forms a predicate of GQs, based on the plural individuals in A (as in Cand from Križ and Spector, 2017, ex. (30)):  
(1)[S](A)= λQ.∃x∈A&∃A'(A'⊆{x':x'≤x}&Q=λP.∃x[A'∩P≠∅])
a. Mary is required to read what Sue is.
b. What Sue is required to read can be read in one week.

a. Mary is required to read the books Sue is.
Suppose that Sue is required to read [W&P and BK] or [MB and SE] (required>or) and nothing else. The sentence need not be a presupposition failure and will entail that the same requirements were made of Mary.
b. The books that Sue is required to read can be read in one week.
Suppose that Sue is required to read [W&P and BK] or [MB and SE] (required>or) and nothing else. The sentence need not be a presupposition failure and will entail that each pair of books that can satisfy the requirements can be read in one week.

The contrast can be explained if higher order quantification is impossible when variables (prior to type shift) range over singular individuals. And this constraint, in turn, leads to the prediction for MS stated in (49).

6.2. Floating quantifiers

Consider the following example from Križ, 2015, p. 192.

(54) Nina weiß, wo man überall Käse kaufen kann.
*Nina knows where one everywhere cheese buy can
‘Nina knows all the places where we can get cheese.’

Križ points out that MS is impossible in this example and that this impossibility is to be attributed to the expression *überall*. (If the expression is removed, MS is possible.) His explanation is based on a property that he attributes to expressions such as *überall* and *all* which he calls *homogeneity removal*. I would like to point out that the approach developed here provides an alternative that relies only on the semantic type of *überall*: on the assumption that it has a semantic type analogous to that of *all*. *All* is analyzed as an expression that combines with a plural individual and returns a generalized quantifier (or alternatively combines with a predicate of individuals and returns another predicate of individuals). By analogy, *überall* will combine with a plural location (the trace of the *wh*-phrase *wo* in (54)) and return a generalized quantifier over locations. From this, it follows that the trace of *wo* must range over locations and not generalized quantifiers, and this, in turn, predicts absence of MS (under the approach developed here).

But an additional prediction is made, namely that *überall* can be introduced in a lower position in successive cyclic *wh*-movement while still allowing for MS. The crucial observation is that the trace in the base position in Spector’s representation of the higher-type meaning can be interpreted as a low-type variable (one that can appear in an argument position). In (22), for example, it is only an intermediate trace (Q) that is interpreted as a higher type variable, whereas the lower trace x is interpreted as variable of a lowest type.

49 See Heim, Lasnik and May 1991. Of course things will not change if *überall* combined with a predicate of locations and returned a new predicate of locations.
(22)' **Higher-Order Quantification:**

**LF:** Wh shift(restrictor) \( \lambda \text{Qett we}_1 \) are required Q \( \lambda \text{x. PRO}_1 \) to read x for this class?

We thus predict MS to be distributed in the following examples as indicated, a prediction that corresponds to the judgments of a few speakers of “Austrian German” with whom I’ve consulted.\(^{50}\)

(55) **Was kann ich alles zusammenmischen sodass es eine Explosion gibt?**

What can I all together-mix so-that there an explosion is MS possible

(56) a. **Was kann ich alles tun sodass ich eine gute Note kriege?**

What can I all do so-that I a good grade get MS possible

b. **Was alles kann ich tun sodass ich eine gute Note kriege?**

What all can I do so-that I a good grade get only MA

(57) a. **Was kann ich alles mit 3 Euros kaufen?**

What can I all with 3 Euros buy MS possible

b. **Was alles kann ich mit 3 Euros kaufen?**

What alles can I with 3 Euros buy only MA

7. **Pragmatic constraints on MS**

Under the proposal made in this paper, two formal conditions must be met for MS to be possible: (a) an existential operator must intervene between a *wh* operator and one of its traces and (b) a trace in the scope of the existential operator must receive a higher-type interpretation (range over GQs). In sections 5 and 6, I tried to investigate these constraints focusing on environments where they are not met. While the availability of implicit domain restrictions makes it difficult to reach firm conclusions, I think that we have seen a few contrasts that can be taken to support the general outlook.

However, it is well known that MS is constrained by pragmatic factors (Groenendijk and Stokhof, 1994; van Rooij, 2004; van Rooij and Schultz, 2006). My hope, following George, 2011 (section 6.1.2), is that the relevant pragmatic factors can be thought of as considerations that enter into disambiguation. For example, following van Rooij, we might claim that a question must have a useful function in guiding action and that the MS interpretation cannot serve this function unless the relevant pragmatic conditions are met. While this line of thought needs to be worked out, I think there are good reasons to think that the pragmatic considerations entertained in the literature are not sufficient to constrain MS, and that formal conditions are needed as well. In addition to the considerations discussed in sections 5 and 6 (and to George, 2011, section 6.1.2), I would like to mention an important argument made in Xiang, 2016.

Xiang points out that if the pragmatic conditions discussed in the literature were taken to be sufficient we would incorrectly predict the existence of what she calls “mention n readings”.

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\(^{50}\) Thanks to Martin Hackl, Patrick Grosz and Manuel Križ for consultation.
The conditions allow MS whenever there is a salient practical problem that would be resolved with (what would otherwise be) a partial answer to a question. So if we need to fill the car with gas, knowing one convenient place where one can get gas would be sufficient. Hence Mary knows where one can get gas? can be paraphrased as the statement that she knows one location where gas is available. But if the pragmatic conditions were sufficient, we would expect other practical problems to lead to very different demands from a partial answer leading to novel interpretations that have not been reported in the literature.

Suppose there was a practical problem that could only be resolved if we knew two places where we could get gas. If the pragmatic accounts were right, an answer to a question such as where can one get gas? what gas stations are open? etc. would need to specify two and no more than two locations. Assume, for example, that I am told I would be executed unless I can mention two locations where one can get gas. The practical problem (avoiding execution) cannot be resolved by a standard MS answer to the question, and if the pragmatic conditions have to be met, this should disfavor a standard MS reading. But if the pragmatic approaches were correct, we should expect to find a mention-two reading, which we don't.

(58), for example, is a sensible thing to utter if the speaker thought Mary knew an MA answer to the question. MS would be insufficient because the practical problem is not resolved and this can be taken to argue that the pragmatic constraints are indeed active. But what is important for Xiang’s argument is the prediction made by the pragmatic accounts, namely, that in this context the sentence would receive an interpretation that can be paraphrased with the statement that Mary knows two locations where one can get gas, (58)a, or two gas stations that are open, (58)b, and this does not seem to be the case.

(58) What you just told me – this threat of an execution – is of course disturbing. But I’m not worried, I can ask Mary:
   a. She knows where one can gas.
   b. She know what gas stations are open.\(^{51}\)

In fact, the pragmatic accounts predict many other types of mention-x readings that I do not think are available. Suppose Mary is missing one professor for a committee (and that anyone would do). If she knew of one available professor, it would be true to say that she knows who can serve on the committee (on the MS reading). Suppose, however, that her practical problem does not require that much knowledge. Suppose that all she needs to know is a department that has a professor available in it, so that she can call and have the professor sent over. Suppose further that she has this information available – the math dept. has a few available Profs. I think that the first two sentences in (59) will be true but (59)c will be false.

(59) a. Mary knows who can send her a professor.
   b. Mary knows what kind of professor can serve on the committee. (A math professor.)
   c. Mary knows which professor can serve on this committee. (A math professor.)

\(^{51}\) Although the judgment seems rather clear to me, we expect the facts (here and in (59)) to be contaminated by implicit domain restriction (and to become sharper when we introduce quantifiers and consider differential mention x).
As far as I can tell, the pragmatic accounts predict that (59)c should get a mention-department reading. Specifically, the partial answer to the question specifying that a professor from the math department is available resolves the salient practical problem of knowing who to call.

What Xiang’s example teaches us is that there is no mention-n interpretation. What (59) teaches us is that there is no mention-department interpretation. There is a very specific MS interpretation, which can be accessed only if certain pragmatic conditions are met. But these conditions are not sufficient. There are formal conditions as well which I hope to have helped elucidate.

8. Conclusions

MS is not compatible with Dayal’s notion of an answer. To deal with this problem, I offered a new Answer operator in section 4, which differs from AnsD in two different ways. First instead of demanding that the question denotation, Q, have a maximally informative true member, Ans demands that Q have a member that can identify the cell in the partition to which the actual world belongs (that Q have a cell-identifier). And second, since the cell-identifier need not be the strongest true proposition in Q, we let the output of Ans be the set of true propositions that entail the cell identifier. MS arises whenever the output of Ans has more than one member. There are various empirical consequences to this account of MS that I investigated in sections 5-7.

The demand for cell identification makes it natural to ask whether the converse demand holds as well, namely the demand for NV: not only should every cell be identifiable by a member of Q, but also every member of Q must identify a cell. NV was supported in section 3, leading to the final proposal in (37), which could be restated (as pointed out by Schwarzschild) as the demand that point wise exhaustification provide us with the necessary partition – (38). Either way, we resolve the problem of question duality that was introduced in the sections 1-2.

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The processing cost of Downward Entailingness: the representation and verification of comparative constructions

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Abstract
We bring experimental considerations to bear on the structure of comparatives and on our understanding of how quantifiers are processed. At issue are mismatches between the standard view of quantifier processing cost and results from speeded verification experiments with comparative quantifiers. We build our case in several steps: 1. We show that the standard view, which attributes processing cost to the verification process, accounts for some aspects of the data, but fails to cover the main effect of monotonicity on measured behavior. We derive a prediction of this view for comparatives, and show that it is not borne out. 2. We consider potential reasons – experimental and theoretical – for this theory-data mismatch. 3. We describe a new processing experiment with comparative quantifiers, designed to address the experimental concerns. Its results still point to the inadequacy of the standard view. 4. We review the semantics of comparative constructions and their potential processing implications. 5. We revise the definition of quantifier processing cost and tie it to the number of Downward Entailing (DE) operators at Logical Form (LF). We show how this definition successfully reconciles the theory-data mismatch. 6. The emerging picture calls for a distinction between the complexity of verified representations and the complexity of the verification process itself.

Keywords: quantification, monotonicity, negation, comparative constructions, Logical Form, adjectival antonyms, decomposition, quantifier processing, speeded verification, reaction time.

1. The landscape
1.1. Monotonicity
That monotonicity is a property of many natural language quantifiers has been recognized since Barwise and Cooper (1981). Monotonicity is defined by entailment patterns:

(1) a. A quantifier Q is Upward Entailing (UE), if \( A \subseteq A' \Rightarrow Q(A) \subseteq Q(A') \)
   b. A quantifier Q is Downward Entailing (DE), if \( A \subseteq A' \Rightarrow Q(A') \subseteq Q(A) \)

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c. A quantifier Q that is neither UE nor DE is non-monotone

Quantifiers in richer structures such as Q(A)(B) may be UE or DE on their restrictor (A) and nuclear scope (B) arguments. We illustrate this with more than two and fewer than three. As \{tall men\} ⊆ \{men\} and \{have a red beard\} ⊆ \{have a beard\}, the following entailments hold:

\[
\begin{align*}
\text{(2)} & \quad \text{a. left UE: } [Q \text{ More than two}][A \text{ tall men}] [B \text{ have a beard}] \\
& \quad \Rightarrow [Q \text{ More than two}][A \text{ men}] [B \text{ have a beard}] \\
\text{b. right UE: } [Q \text{ More than two}][A \text{ tall men}] [B \text{ have a red beard}] \\
& \quad \Rightarrow [Q \text{ More than two}][A \text{ men}] [B \text{ have a beard}] \\
\text{c. left DE: } [Q \text{ Fewer than three}][A \text{ tall men}] [B \text{ have a beard}] \\
& \quad \Leftarrow [Q \text{ Fewer than three}][A \text{ men}] [B \text{ have a beard}] \\
\text{d. right DE: } [Q \text{ Fewer than three}][A \text{ tall men}] [B \text{ have a red beard}] \\
& \quad \Leftarrow [Q \text{ Fewer than three}][A \text{ men}] [B \text{ have a beard}] 
\end{align*}
\]

1.2. Monotonicity and processing: verification and the DE Cost Effect

How are sentences with monotone quantifiers processed and verified? Barwise and Cooper famously proposed a witness set (WS) verification algorithm that is based on iterated sampling. It distinguishes UE from DE quantifiers in terms of verification complexity (cf. Szymanik, 2016 for a comprehensive recent review). The clearest case may come from proportional quantifiers: with UE ones, (e.g., more-than-half), a single positive Example found in a scenario suffices for verification by the WS algorithm. Yet with their DE counterparts (less-than-half), exhaustive scrutiny of the whole scenario is required. Thus here, the WS algorithm requires more steps to verify a DE sentence than its UE counterpart. This verification method is predicted to bring about behavioral UE/DE differences. As Barwise and Cooper comment: “we predict that response latencies for verification tasks involving decreasing quantifiers would be somewhat greater than for increasing quantifiers...These predictions are based on the complexity of the checking procedure we have suggested” (p. 192). Though not explicitly discussed by Barwise and Cooper, falsification with this checking method reverses the complexity of the WS algorithm and, correspondingly, the prediction (at least with proportional and degree quantifiers): the WS strategy above predicts that falsifying DE sentences should be faster than falsifying their UE counterparts (and similar, or even equal, to verifying their UE counterparts). We can use verification time, quantified using reaction time (RT) measurements in a verification experiment, to test this theory. Imagine a verification experiment with a 2×2 design, in which the Polarity contrast (RTDE – RTUE) is pitted against Truth-value (RTF – RTT). Under the WS algorithm, no main effects (of a Polarity factor across Truth-value, or a Truth-value factor across Polarity) are expected. Yet we expect a Polarity×Truth-value interaction, due to the DE/UE ordering reversal in the case of falsification: longer RT in True DE and False UE verifications (Figure 1a).
Actual results of such an experiment were in fact already available at the time of Barwise and Cooper’s writing: Just and Carpenter (1971) presented data from speeded verification, in which quantifiers Polarity was pitted against Truth-value. Sentences with UE and DE degree quantifiers were verified against scenarios that contained 2 black and 14 red dots (or 14 black and 2 red dots).\(^2\) Half of the scenarios made each sentence true, and the other half made each sentence false:

\[(3) \begin{align*}
\text{a. UE: } & \text{Many of the dots are black} \\
\text{b. DE: } & \text{Few of the dots are red}
\end{align*} \]

Just and Carpenter found a Polarity × Truth-value interaction effect, as the WS algorithm would later predict. Yet they also obtained a main effect for Polarity, RT\(_{DE}\) > \(\text{sig } RT_{UE}\) (illustrated in Figure 1b), not predicted by the WS algorithm. We call this main effect the DE Cost (DEC) Effect. It is found across Truth-values, hence it is independent of verification.\(^3\)

The shape of the interaction effect (disordinal: the slopes of the imaginary lines connecting the RTs for each quantifier are opposite to one another) is consistent with the WS, yet the unexpected main effect of Polarity suggests that the processing complexity of quantified sentences has two independent components. Indeed, Just and Carpenter proposed an account that reflects this independence. It attributes the main (DEC) Effect to costly lexical decomposition \([\text{few=NOT(many)}]\), and the Polarity × Truth-value interaction to attentional shifts during verification.\(^4\)

\[^2\] Many and few are arguably ambiguous between adjectival and quantificational denotations. As we show below, the same results are obtained from unambiguously proportional determiners (more/less-than-half).

\[^3\] A comment by Dan Goodhue played an important role in clarifying this point.

\[^4\] They proposed an attentional strategy, imposed by the scenario, which forces a participant to attend to the larger set of dots first; an attentional shift to the smaller set (driven by sentence content) is costly. In the experimental context, the UE stimulus sentence in (3a) is true iff followed by an image in which the larger set of 14 dots is in the predicate color. Focusing on this set for Truth-value determination is appropriate, making for a speedy response. However, this UE sentence is false when the smaller set of 2 dots is in the predicate color; attention must therefore be shifted to the larger set for the determination of Truth-value, and as the shift is supposedly costly, a longer response time is expected. The same logic applies to the DE case (3b), but in reverse.
1.3. Prospectus

This note focuses on one of the two components, the DEC Effect – the processing signature of the monotonicity of degree quantifiers across Truth-value. DEC can be expressed thus:

\[ \Delta RT = RT_{\text{DE}} - RT_{\text{UE}} > 0 \]

RT\text{DE} and RT\text{UE} are speeded verification times of the sentences containing UE and DE quantifiers, respectively. The DEC Effect is robust and has been repeatedly reported (Geurts and van der Slik, 2005; Deschamps, Agmon, Loewenstein and Grodzinsky, 2015). It is at the heart of our exploration of the representational and verification complexity of comparative quantifiers via empirical tests of their perceptual complexity. We try to identify the source of the DEC Effect and see how such an understanding bears on the semantics of comparatives.

For the remainder of Section 1, we review some recently published experimental tests, which seem to support a decompositional analysis of DE quantifiers along the lines of Just and Carpenter (cast in current lingo). We proceed to a puzzle that arises with respect to a DEC Effect found for comparative constructions and consider possible solutions (Section 2). We rule out one of these through an experiment we report (Section 3) and then delve into the details of the Downward Entailingness in the context of comparative quantifiers (Section 4): we motivate a decompositional analysis of more- and less-comparatives (Büring, 2007a,b; Heim, 2006; Rullman, 1995) and show that each of these posits a different number of DE operators in these comparatives. This difference may help in revising the DEC Effect to fit our experimental data. In Section 5, we redefine the DEC Effect accordingly and show how this definition not only helps to account for the problematic data from comparatives, thereby lending support to the decompositional analysis, but also serves as a tool for the identification of hidden DE-operators.

In Section 6, we reflect on the view that the processing complexity of quantifiers is determined by two components. First, the Polarity main effect is captured by DEC. We call it the representational component, as it is determined by the structural complexity of the quantifiers at issue. Second, the Polarity × Truth-value interaction is in keeping with the WS algorithm. We therefore call it the verificational component. All in all, we show how results that come from the continuous time domain can be explicitly mapped onto linguistic representations and brought to bear on linguistic theory, even though this theory only features categorical variables.

1.4. Recent experimentation on quantifier monotonicity

Deschamps et al. (2015) report the results of three speeded verification experiments with polar quantifiers, in which matched auditory sentences were coupled with images that contain blue and yellow circles in varying proportions:

\[ \text{a. More than half of the circles are blue} \]
Each trial began with a visual fixation point followed by an auditory sentence, which was then followed by an image which participants were asked to verify (Figure 2). In addition to measuring a DEC Effect, these experiments tried to see whether DE Cost is affected by properties of the truth-making scenario (in this case, by Weber’s Law). Therefore, the blue/yellow proportion in the scenarios was varied along a seven-valued parameter. This proportion determined both Truth-value (T/F) and task difficulty. As the proportion approached 1, the task was more difficult. In Figure 2, for example, we see a more difficult true case and an easier false one:

![Figure 2: form, content and time-course of stimuli.](image)

Three tests using the sentences shown in (5)-(7) and a host of control conditions were carried out in the same verification paradigm. RT functions, time-locked to image onset as seen in Figure 2, behaved in keeping with the inequality in (4) modulo Weber’s Law, across all seven values of the proportion parameter and across True and False instances. Figure 3 collapses participants’ scores across Truth-value and proportion and presents the DEC Effect for the polar pairs in (5)-(7) by showing the difference between means (***=p<.001). The effect was robust, manifesting in almost all individual participants.

---

5 We collapse across proportions because no DEC×proportion interaction was found, see Deschamps et al. (2015) for details.
Deschamps et al. drew several conclusions from this result. Of these, one is of interest here: a DEC Effect is found in a variety of instances but not in control conditions\(^6\).

2. Problems and possible solutions

2.1. The RT puzzle in comparatives

Among the cases tested, was the pair of comparative sentences (7).\(^7\) It contains polar quantifiers (more, less), and as such, it seems at first blush that a DEC Effect is also expected. But processing complexity is determined by properties of generalized quantifiers,\(^8\) which is reflected by entailment patterns. These are mixed in comparatives – each sentence seems to have a UE and a DE component, except in reversed order:\(^9\)

\[(8)\]
\begin{align*}
\text{a. More cats than snakes died } & \Rightarrow \\
\text{More mammals than snakes died } & \Rightarrow \\
\text{b. More cats than reptiles died } & \Rightarrow \\
\text{More cats than snakes died } & \Rightarrow
\end{align*}

\[(\{\text{cats}\} \subset \{\text{mammals}\})\]

\[(9)\]
\begin{align*}
\text{a. Fewer mammals than snakes live in deserts } & \Rightarrow \text{Fewer cats than snakes live in deserts } \\
\text{b. Fewer cats than snakes live in big cities } & \Rightarrow \text{Fewer cats than reptiles live in big cities}
\end{align*}

A natural construal of the DEC Effect here is to fix it to the cumulative monotonicity of a sentence. Decomposing each comparative left-to-right, we obtain that (7a-b) do not differ in total DE-ness, as that they both contain a DE environment and a UE environment. We can therefore compute the predicted relation between their verification times under DEC:

---

\(^6\) Deschamps et al. Compared quantifier polarity to the direction of algebraic inequalities. When the expression to be verified was not a sentence, but rather, a quasi-algebraic expression with “<” or “>”, not polarity effect analogue was found.

\(^7\) Note that the WS verification algorithm cannot work for comparatives, as the quantifier has no restrictor which can be sampled to determine Truth-value. See Section 6.2 for further elaboration.

\(^8\) Deschamps et al. also consider a frequency-based account of the DEC Effect, by which it is due to differences in the lexical frequency between DE and UE quantifiers. They reject this account on several grounds, one of which coming from frequency differences between UE quantifiers (i.e., \(f_{\text{more}} > f_{\text{many}}\)) that do not manifest in the RT domain (i.e., in sentence verification, \(RT_{\text{more}} < RT_{\text{many}}\)).

\(^9\) These entailment patterns are among the reasons for the characterization of these as “A-not-A” (Schwarzschild, 2008).
Deschamps et al., however, found that in comparatives, \( RT_{(7b)} > RT_{(7a)} \), or \( \Delta RT > 0 \). By (10), this effect is not expected. We now address possible reasons for this puzzle.

2.2. Possible solutions

We are aware of three logically possible explanations for this theory/data mismatch:

I. The experimental results are compatible with alternative interpretations.

II. Assumptions regarding comparative structure are incorrect.

III. The definition of DEC is incorrect.

What follows is a consideration of these possibilities, and an amended account of the data.

3. A possible experimental wrinkle and its fix

3.1. The issue

Consider the experimental paradigm illustrated in Figure 2, where all image stimuli are composed of objects in two colors (blue and yellow). Prior to testing, participants are informed that these two colors would be the only ones to feature in the images. Sentences (5)-(6) contain a single color term, realized in the right argument of the quantifier – the last word in the sentence. Correct Truth-value judgment in the binary-choice task requires a complete parse of the sentence.

Comparatives are different. Consider the phrasal comparatives used in Deschamps et al.’s study, repeated here in (11): they contain two color terms, that is, both blue and yellow.

\[
\begin{align*}
(10) & \quad a. \ RT_{(7a)} = RT_{UE} + RT_{DE} \\
b. \ RT_{(7b)} = RT_{DE} + RT_{UE} \\
\text{hence} \\
c. \ RT_{(7a)} &= RT_{(7b)}, \text{ or } \Delta RT = RT_{DE} – RT_{UE} = 0 \quad \text{(at the very least: } \neg (RT_{(7b)} > RT_{(7a)}) \text{)}
\end{align*}
\]

In the context of the task, a participant has enough information to perform correctly with only part of the sentence, as parsing the first part of the comparative is sufficient for verification. If the first argument is blue, she can safely conclude that the second must be yellow and vice versa. Attending to the rest of the sentence would convey no further critical information.

But what would make her stop listening amid sentence? Recall that the task involves speeded verification, i.e., participants are motivated to decide and respond as fast as they can after the image appears. In a repetitive experimental session such as ours (>200 trials per run), compliant participants act efficiently: they try to perform as instructed, but at the same time seek to reduce effort. After a few trials, they can quickly learn that a partial parse is
sufficient. This may result in the deployment of a time-saving strategy with no accompanying loss of accuracy.

If this strategic response method is possible, we should compute the DEC Effect only on the first part of the comparative. This would make the comparative quantifier mono-argumental, akin to (5a-b). This would make (7a), more-comparative, a UE sentence; and (7b), a less-comparative, a DE one. With this strategy, the observed result, ΔRT>0, is expected.

Deschamps et al.’s experiment cannot rule out this interpretation. We must therefore modify the experimental paradigm so as to rule out this strategic performance option and ensure that the experiment tests what it aims to test. This is what we did in a new experiment, run with a group of Hebrew University undergraduate students (n=22), all native Hebrew speakers, who participated for either payment or credit giving their informed consent. The experiment was approved by the Hebrew University Research Ethics Committee.

3.2. Materials and methods

The experiment used Hebrew versions of the sentences in (11), but did so in a context that forced participants to produce a complete parse of the comparative. The experimental design used the above stimuli but added an image type. That is, like before, each image contains a proportion of circles in two colors, but these were picked out of three colors (red, blue, and yellow), producing combinations as in (12), Figure 4:

(12)

a. There are more blue circles than yellow circles.

b. There are fewer yellow circles than red circles.

c. There are more red circles than blue circles.

Figure 4: design and conditions of the present comparatives experiment.

Some images contained a color that was not mentioned in the sentence, which made the sentence infelicitous. Participants were instructed about these possibilities and were asked to mark these as MisMatches (MM). They were given a third button in addition to the true and false ones (MM, 12c). In this context, the correct response was now discoverable only at the end of the sentence. Participants were forced to pay attention throughout the sentence and parse the complete comparative with both its UE and DE parts. No DEC Effect was therefore predicted.

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10 The Hebrew sentences: Yeš yoter/paxot 'igulim kxulim me-’adumim, etc.
11 Although it would also be possible to create a MisMatch using the first color term, we only tested instances in which the mismatch was realized at the end of the sentence, namely those in which the offending color was in the comparative.
This 2×3 design, with Polarity and Image Type as factors and 20 stimuli per type, led to a test that had 120 trials, preceded by a short training session. Sentence-image stimuli were presented in a random order using a Presentation® code.

3.3. Results

The results draw a clear picture (Table 1, Figure 5): a. mean error rates were low across all conditions (in parentheses, Standard Deviations). b. RTs present a main Polarity effect (the difference between the means for more and less, annotated blue and red in Table 1, across Truth-value); that is, even in the present test paradigm, where participants are forced to parse the sentence in its entirety, there is a significant difference between the processing of more- and less-comparatives across Truth-value (F(1,21)=97.236, p<.0000001). We return to other aspects of these data later.

<table>
<thead>
<tr>
<th>Sentence</th>
<th>Truth-value</th>
<th>Mean proportion correct (SD)</th>
<th>Mean RT in msec (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. There are <em>more</em> blue circles than yellow circles</td>
<td>T</td>
<td>0.954 (0.04)</td>
<td>897 (181)</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>0.885 (0.08)</td>
<td>1047 (175)</td>
</tr>
<tr>
<td></td>
<td>MM</td>
<td>0.940 (0.05)</td>
<td>798 (100)</td>
</tr>
<tr>
<td>b. There are <em>fewer</em> blue circles than yellow circles</td>
<td>T</td>
<td>0.898 (0.09)</td>
<td>1022 (208)</td>
</tr>
<tr>
<td></td>
<td>F</td>
<td>0.856 (0.07)</td>
<td>1115 (195)</td>
</tr>
<tr>
<td></td>
<td>MM</td>
<td>0.950 (0.04)</td>
<td>831 (112)</td>
</tr>
</tbody>
</table>

Table 1: colored RTs are in keeping with the bar-graph below.

![Figure 5: the Polarity main effect with UE (blue) vs. DE (red) sentences (RT in msec). Error bars mark SEM.](image)

3.4. Interim conclusion

We can assert with confidence that the RT puzzle is not due to an experimental artifact, as it persists even when we can guarantee complete processing of the comparative. Next, we reexamine the assumptions that led to the puzzle in the first place. For the RT mismatch to be solved, one needs to look deeper into the structure of comparatives in an attempt to uncover what hidden complexity elements they may contain.
4 Comparatives and monotonicity

4.1 The need for a revised analysis

In this Section, we consider how comparatives should be analyzed. We present two well-known puzzles that the monotonicity-based analysis of comparatives faces. a. NPIs, licensed only in DE environments, are nonetheless licensed in the UE part of less-comparatives. b. an ambiguity in less-comparatives is mysteriously resolved by the insertion of an NPI. Neither puzzle arises in more-comparatives. We review a decompositional solution that derives the UE-ness of the comparative clause in less-comparatives from two DE operators. We then proceed to point out problems in this analysis, which have led some investigators to endorse an alternative, non-decompositional, lexical account, which we then sketch. Finally, as we later argue that our experimental results help to fortify the decompositional account, we demonstrate that phrasal comparatives – the cases we tested – are indeed relevant.

4.1.1 An apparent mismatch

There is a well-known mismatch between entailment patterns and the licensing patterns of Negative Polarity Items (NPI) in comparatives (exemplified here with phrasal ones): above, in (8)-(9), more/fewer-comparatives were shown to have “mixed”, A-not-A, monotonicity. One would expect this pattern to correlate with that of NPI-licensing. That is, all DE environments, and only those, should license NPIs. Yet the observed correlation is only partial: as expected, more licenses an NPI just in the DE than-phrase (14), but fewer licenses a NPI not only in its left, DE argument (15a), but also in its right, UE argument (15b) (Seuren, 1973):

(14) a. #This city has more cats that ever meow than snakes (NPI in a UE environment)  
    b. This city has more cats than snakes that ever bite (NPI in a DE environment)

(15) a. This city has fewer cats that ever meow than snakes (NPI in a DE environment)  
    b. This city has fewer cats than snakes that ever bite (NPI in a UE environment)

Where does this mere partial correlation between NPI-licensing and entailment patterns come from? The comparative part of (15b) is UE by its entailment pattern, but the NPI within it cannot be licensed unless in the scope of a DE operator. This mismatch not only creates a linguistic puzzle, but also a cognitive one. An explanation proposed to the merely partial entailment/NPI licensing correlation might come to the rescue of the DEC Effect puzzle. Let’s dig deeper.

4.1.2. Ambiguities in comparatives and their resolution with NPIs

To get to the bottom of the issue, we look into the comparative part of the less-comparative by returning to Rullman’s (1995) discussion of a curious ambiguity (again following Seuren). Assuming that a jet plane can fly at heights between 1000-20000ft, we get this ambiguity:

(16) The helicopter is flying less high than a jet plane can
The processing cost of Downward Entailingness

Context: jets can fly at 1000-20000ft
Reading 1: The helicopter is flying below 1000ft
Reading 2: The helicopter is flying below 20000ft

The parallel *more*-comparative evinces no such ambiguity:

\[(17)\] The helicopter is flying higher than *a jet plane can*
Reading: The helicopter is flying above 20000ft

Returning to *less*-comparatives, Rullman shows that only reading 1 must be analyzed as containing a DE environment. Assume that \(\{x/x\text{ is a cargo plane}\} \subseteq \{x/x\text{ is a plane}\} \). Then (18a) entails (18b) only on the “less-than-minimum” reading:

\[(18)\]

a. The helicopter is flying less high than a plane can \(\Rightarrow\) 
b. The helicopter is flying less high than a cargo plane can

That is, if the helicopter is flying at a (maximal) height that is below the minimum height a plane can fly (=1000ft), then in particular, it is flying below the minimum height at which cargo plane can fly. By contrast, this entailment does not go through on a “less-than-maximum” reading: if the maximum height that a plane can achieve is 20,000ft (below which the helicopter is flying), then it does not follow that the helicopter is flying below the maximal height a cargo plane can reach (as this plane’s maximum height may be less than 20,000ft). It is entirely possible, then, that the helicopter in (18a) is flying higher than the cargo plane but lower than the maximum height a plane can reach (20,000ft), thereby falsifying (18b). The representation of the “less-than-maximum” reading thus does not contain a DE environment.\(^{12}\) Thus generally, as Rullman (p. 87) puts it, on the “less-than-minimum” interpretation, *less than*-comparatives are DE.

Moreover, NPIs are only licensed on the “less-than-minimum” reading, because it is the only reading whose representation contains a DE environment. Indeed, (19) is not ambiguous:

\[(19)\] The helicopter is flying less high than *any plane can*

How can these complex facts be explained? Below, we show how lexical decomposition (Rullman, 1995; Heim, 2006; Büring, 2007a,b) accounts for these by breaking DE quantifiers into pieces. We will later argue that this analysis, coupled with straightforward assumptions about processing, accounts for the RT puzzle with which we began.

4.2. A sketch of the decompositional account

Below, we conflate the three accounts just mentioned into one, as they all share the relevant property which we recruit in order to account for the processing results. This account is built out of three ideas. I. quantifiers undergo lexical decomposition; II. the comparative’s missing

\(^{12}\) No such ambiguity is observed with the UE –*er* – (i) only has the “more-than-maximum” reading:

\[(i)\] The plane is flying high-*er* than a helicopter can
part, taken to be a relative-clause-like constituent, is copied from the main clause; III. some word parts cannot compose due to type mismatch, and are forced to QR. More explicitly:

I. Lexical Decomposition: higher decomposes into high+–er, and less into little+–er. Lexical entries and types: adjectives contain a degree argument (20a). –er is a comparative DE operator over sets of degrees, which checks for an inclusion relation between two degree segments. It is designed to deliver the right meaning when composing with both UE and DE adjectives (20b). Little (20c) is a DE operator (essentially, a negation), whose meaning is “not as much as d” (type <d<<dt>t>>), where d is a generalized quantifier over degrees (type <dt,t>). Both –er and little are parts of a DegP, but they are blocked from composing due to type mismatch, which forces –er to QR at LF. Can is the usual existential modal (20d).

(20) a. [[high]]w = λd. λx. Heightw(x)>d  
b. [-er] = λP: λQ: d. P ⊂ Q  
c. [[little]] = λd. λP: P(d)=0  
d. [[can]] = λp. ∀w∈WAcc: p(w)

II. Copy: at LF, the comparative has a silent complement for can – a copy of the complement of the main predicate (excluding tense and –er). Very schematically:

(21) The helicopter is flying high–er [than a plane can [fly high]]

III. QR: The main clause and the comparative clause, then, are sets of degrees, which –er takes as its arguments. As -er cannot compose with little, it must raise, which makes it outscope little at LF. Nothing blocks either -er or little from outscoping the modal. As a result, the minimum/maximum ambiguity can be derived, because these scopal orderings are possible:

(22) a. er > little > modal  
b. -er > modal > little

The less-than-minimum/maximum ambiguity is thus derived via two different LFs – little works as a negation, and its scope relative to the existential modal determines the meaning:

(23) a. LF1, the “less-than-minimum” reading of the less-comparative:  
[-er than]1 wh3[t3 little]4[can [a plane fly t4 high]]t1 little]2[The helicopter is flying t2 high]  
b. LF2, the “less-than-maximum” reading of the less-comparative:  
[-er than]1 wh3[can [t3 little]4[a plane fly t4 high]]t1 little]2[The helicopter is flying t2 high]

This scopal account also works to license the NPI in (19), as it posits a DE operator that scopes over the comparative. And while this analysis overgenerates,13 as Heim herself points out, it nonetheless marks an advance in that it is fully compositional.14,15

13 Example (19) is unambiguous, as only the “less-than-minimum” reading is available. And yet, Heim’s account stops short of blocking the other, “less-than-maximum”, reading because it provides no way to block the modal from outscoping little when the disambiguating NPI is present.
14 Another issue pointed out by Heim is the lack of full synonymy between little α and its antonym. To get
4.3. Counting DE operators

The setup in (23) opens the door to a new perspective on the processing complexity of comparatives. Assume lexical entries as in (20), by which both –er and little are DE operators. For each of the polar comparatives (24) we obtain a count of the number of these (25):

(24) a. X is higher than Y  
   b. Y is less high than X

(25) DE count  
   a. higher (1): [–er than]₁ \(\text{wh}_2[Y \text{ t} \text{ high}][X \text{ is } t_1 \text{ high}]\)  
   b. less high (3): [–er than]₁ \(\text{wh}_3[[I_t \text{ little}]]₄[Y \text{ t} \text{ high}][[I_t \text{ little}]]₂[X \text{ is } t_2 \text{ high}]\)

Next, we use the measure of processing complexity in order to translate this count into predictions about RT in verification tasks.

5. DEC redefined: adjudicating between the accounts

5.1. A revised DEC Effect

A reminder: the DEC Effect, whose definition is based on the monotonicity properties of environments within sentences, has not been a complete success. It correctly predicted the results of some DE/UE experimental contrasts but failed to account for the results for comparatives: contrary to fact, it predicted that \(\Delta RT_{\text{less-more}} = 0\), as both more and less comparatives have a DE and a UE part.

The decompositional analysis we have seen supplies a 3:1 proportion of DE to UE operators in less/more comparatives. If DEC can be tied to this count, the RT contrast that is repeatedly found would be accounted for. But for that, a change in perspective on the processing complexity of quantifiers is required. DEC will no longer be based on the DE-ness as measured by inferential properties. Rather, it will be expressed in terms of the number of DE operators, \(n_{DE}\) in a given LF. Our proposal builds on \(n_{DE}\), the number of DE operators in an LF:

\[\text{around this problem, Heim proposes to stick to the “non-evaluative, open-scaled, adjectives in the comparative (like less fast – slower, less old – younger), which do seem to form truth-conditionally equivalent pairs in simple sentences” (Heim, 2006, p. 21).}\]

\[\text{Rullman doubts the validity of the restricted decomposition account. He observes that the less-than-minimum/maximum ambiguity is more widespread than expected: in addition to the previous cases (i), it is also attested in sentences where more combines with its negative antonym (ii):}\]

\[\text{(i) The helicopter is flying less high than a jet plane can}\]
\[\text{(ii) The helicopter is flying lower than a jet plane can}\]

This forces a decomposition of adjectival antonyms, which Rullman stops short of. But Heim and Büring do decompose adjectives, in the spirit of Kennedy (2001), e.g., low=little(high).

\[\text{The DEC may also at some other semantic representation, if one sticks to an account that does not assume LF in its technical sense.}\]

\[\text{See also Hackl (2009); Szymanik and Zajenkowski (2010).}\]
The decompositional analysis takes more-comparatives to contain one DE operator (–er) and less-comparatives to contain three (–er, little). Hence, \( \Delta n_{DE} = 2 \), and the predicted DEC Effect is correct: \( \Delta RT = RT_{fewer} - RT_{more} > 0 \).

5.2. Fitting our results from polar phrasal comparatives to the new DEC

The above analysis pertains to clausal comparatives, which leaves us one step short of deriving the results of our own experiment, in which we showed that phrasal comparatives are fully processed:

(27) a. There are more blue circles than yellow circles
b. There are fewer yellow circles than blue circles

Our discussion thus far featured clausal comparatives, and we therefore need to consider whether phrasal ones, whose semantics is slightly different from their clausal counterparts (e.g., Beck, Hohaus and Tiemann, 2012), fit the bill. The experimental sentences in (27) have the same truth conditions. We focus on their logical forms, as these bear on DEC. The decompositional analysis turns more into many+–er, and fewer into little+many+er; the rest follows as in (20)-(23), resulting in LF representations with an unequal number of DE operators, namely one DE operator for more (28a), but three for fewer (28b).  

(28) a. \([–er \text{ than}]_{1} \text{ wh}_{2}[_{2} \text{ many yellow circles}][\text{there are } t_{1} \text{ many blue circles}] \]
b. \([–er \text{ than}]_{1} \text{ wh}_{2}[_{2} \text{ little}]_{3}[_{3} \text{ many blue circles}][_{1} \text{ little}]_{2}[\text{there are } t_{2} \text{ many yel. circles}] \]

This analysis, then, once coupled with the new DEC, predicts our results.

The theoretical informativeness of the revised DEC goes beyond the data we discussed: by DEC, differential response times in verification experiments with quantifiers (\( \Delta RT \)) should correlate with the differential count of DE operators (\( \Delta n_{DE} \)). Experiments that measure the DEC Effect may therefore serve as a tool for the discovery of hidden DE operators through RT patterns. That is, in every case where there is a UE environment due to two DE operators (or more generally, where \( 2n_{DE} = n_{UE} \)), we expect response times to be elevated relative to “true” UE environments. The processing signature of such operators, even if covert, should be revealed experimentally. We are currently engaged in further experimentation along these lines.

We note, moreover, that other work in our lab may provide preliminary hints regarding differences between adjectives and quantifiers with respect to hidden negation – differences that RH might welcome, but Büring’s approach would not predict, as it gives all negations.

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18 Additional assumptions regarding the copying process in the context of phrasal ellipsis are suppressed, as they are orthogonal to the issue under consideration, namely, they do not affect the number of DE operators at LF.
the same status. At this point, there is little evidence regarding adjectival antonyms and negations that they may conceal, yet Agmon, Deschamps, Loewenstein and Grodzinsky (2016) have begun to explore this issue both behaviorally and though functional MRI. The preliminary evidence they produced suggests a marked difference between the two types: when a two-way ANOVA is performed over data from positive and negative adjectival antonyms and polar quantifiers, an interaction effect emerges. That is, the difference between antonyms is significantly smaller that the difference between polar quantifiers (see also Tucker, Tomaszewicz and Wellwood, 2017 for a recent experimental exploration).

6. Representational and verificational complexity

The new definition of DEC views the representational complexity of a sentence as a central determinant of its processing cost. This complexity is not acknowledged by the standard WS-based view, inspired by Barwise and Cooper, which focuses on the interaction between monotonicity and Truth-value. This view ascribes the longer RTs for DE sentences to the verification procedure and not to the structure of the quantifiers themselves (cf. also Koster-Moeller, Varvoutis and Hackl, 2008). As noted earlier, this algorithm has two predictions for verification experiments with polar quantifiers: a. a Polarity×Truth-value interaction – higher RTs are expected for true DE sentences, compared to their UE counterparts, as is a reversal of this relation for false sentences; b. no main effect – no difference is expected between the mean RTs for DE and UE sentences (Figure 1a). Prediction a is borne out, but prediction b is false (Figure 1b). The present view links complexity to the number of DE operators at LF to explain the main effect. The interaction, we argue, is explicable by the WS algorithm. It follows that a complete account of the RT data requires two components: representational and verificational.

This analysis of the processing data receives further support when data from several studies are broken down by Truth-value and compared. Consider Figure 6a, with Deschamps et al.’s results from a UE/DE pair of simple quantified sentences are analyzed by the factor Truth-value, and compare it to a similar breakdown of the present experiment with comparatives (Figure 6b):

![Figure 6: Polarity×Truth-value interaction in two experiments with sentences containing more (blue) vs. less (orange).](image)

We see a nuanced picture: both studies evince a DEC Effect, attributed to representational complexity. A Polarity×Truth-value interaction is also observed in both, but it takes different
shapes. The interaction for the simple sentences \([F(1,16)=14.755, p<0.001]\) is disordinal, with lines whose slopes go in different directions (Figure 6a). The (smaller) effect for the comparatives \([F(1,21)=7.84, p<0.02]\), by contrast, is ordinal – the lines in Figure 6b, though not parallel, nonetheless have slopes in the same direction.

Assuming verification by the WS strategy, this contrast is expected: when applied to simple quantificational sentences, this strategy expects performance inversion when Truth-value switches (see Bott, Klein and Schlotterbeck, 2013, Szymanik, 2016). For comparatives, no such strategy can be employed, and the lines are indeed near parallel. The slopes in Figure 6b (the difference between RTs for true and false sentences) remain unaccounted for.

Thus, despite various objections to the WS approach to verification, the experimental results, once properly handled, appear in keeping with this approach in places where it applies. We make no claim, though, regarding the algorithm that is used to verify comparatives.

7 Final thoughts

The robust DEC Effect found for phrasal comparatives (i) sharpens our view of the way the processing cost of DE-ness is manifested and shows that the complexity of quantifier processing is bi-componential; (ii) supports a decompositional view of less-comparatives, and (iii) underscores the value of experimental work as a powerful tool for the discovery of hidden linguistic structure.

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Linguistic barriers to logical reasoning: a new perspective on Aristotelian syllogisms

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Abstract. Experimental studies investigating logical reasoning performance show very high error rates of up to 80% and more. Previous research identified scalar inferences of the sentences of logical arguments as a major error source. We present new analytical tools to quantify the impact of scalar inferences on syllogistic reasoning. Our proposal builds on a new classification of Aristotelian syllogisms and a closely linked classification of reasoning behaviors/strategies. We argue that the variation in error rates across syllogistic reasoning tasks is in part due to individual variation: reasoners follow different reasoning strategies and these strategies play out differently for syllogisms of different classes.

Keywords: syllogisms, reasoning errors, individual variation, scalar inferences.

1. Introduction

Our paper investigates the impact of so-called scalar inferences on logical reasoning performance. From almost its outset, the study of the psychology of logical reasoning aimed at identifying common inferences that lead to divergence from logically valid reasoning (Sells, 1936; Wilkins, 1928; Woodworth and Sells, 1935). A long-recognized example of such an inference is the scalar inference ($SI$) from the truth of an existential sentence to the falsity of its universal counterpart, represented by the scheme in (1) (Begg and Harris, 1982; Newstead and Griggs, 1983; Rips, 1994).

$$\text{(1) some Ms are Ks } \overset{SI}{\Rightarrow} \text{ not all Ms are Ks}$$

To see how commonly the $SI$ in (1) seems to be drawn in logical reasoning tasks, consider the argument in (2), from the premise (1) to the putative conclusion (2). We will be looking at the

$$\text{(2) some Ms are Ks } \text{ not all Ms are Ks}$$

1We would like to thank the participants of the “Semantics and Natural Logic” special session of Sinn und Bedeutung 22 for their comments and suggestions. Versions of this work have been presented at the LINGUAE Seminar at Institut Jean Nicod, Paris and the linguistics seminar at the University of Wisconsin at Milwaukee. We wish to thank the audiences of these events for their constructive remarks. This work was supported by grant 1926/14 from the Israel Science Foundation (Crnič), grant 2093/16 of the Israel Science Foundation (Grodzinsky), and a post-doctoral grant from the Edmond and Lily Safra Center for Brain Sciences (Haida).

2An argument that the inference in (1) is not a logical entailment comes from the fact that the negation of an existential sentence is false if its universal counterpart is true. This means that either the indefinite determiner some is not a logical constant of English or the $SI$ of an existential sentence is not a logical entailment. In either case, the inference in (1) is not logically valid. We follow the standard assumption due to Grice (1975) that some is a logical constant, and hence that the inference in (1) is not a logical entailment. See footnote 8 for further discussion.

3Here and below, we use the letters i and e to designate existential sentences by their traditional names from Aristotelian-scholastic logic (see §2 for a compilation of relevant terminology). The difference between i- and e-sentences is that the predicate in the nuclear scope of the indefinite determiner is negated in e-sentences and
impact of the SI of the I-sentence, i.e., at the impact of (1). Take note that the I-sentence functions as the premise of the argument, since this will play an important role for our discussion.

\[
\begin{array}{l}
(1) \quad \text{Some Ms are Ks} \\
(0) \quad \text{Some Ms are not Ks}
\end{array}
\]

accepted by 94% of all subjects

Newstead and Griggs (1983), henceforth N&G, report that, when asked to decide whether the O-sentence “logically follows” from the I-sentence, 94% of all subjects gave a positive response. However, inferences from I-sentences to O-sentences are not logically valid: in Aristotelian logic (AL) as well as in predicate logic (PL) (and all other logics that we are aware of) existential sentences are logically compatible with their universal counterparts. Thus, since the reasoning task targeted logical inferences, 94% of all subjects erred in their judgment. A possible explanation for this high error rate is that the vast majority of subjects not only considered the logical entailments of the I-premise but also its SI. Importantly, the conjunction of the I-premise and its SI logically entails the O-conclusion. This observation suggests that the errors observed in the I-to-O inference task are due to the SI of the I-premise (as already concluded by N&G). Furthermore, the magnitude of the error rate suggests that almost all reasoners computed (and took it into account) the SI of the I-premise.

Next, we are looking at the same reasoners and the same I-sentence, but this time when it functions as the conclusion of an argument. N&G observe that the argument in (3), from the premise (A) to the putative I-conclusion, was judged logically valid by 73% of all subjects. That is, as indicated only 27% of all subjects rejected the validity of the A-to-I inference.

---

4In the experiment instructions, subjects were informed that alphabetic letters, in our example M and K, stand for classes of things. In a follow-up experiment, N&G found that replacing the letters with concrete nouns such as artist or bee-keeper does not lead to significantly different results.

5The language of AL is a proper fragment of the language of PL. Semantically, AL differs from PL in that universal sentences entail their existential counterparts. Thus, in the former all Ms are Ks entails some Ms are Ks and no Ms are Ks entails some Ms are not Ks. Natural language quantifiers are Aristotelian in the sense that they entail (or presuppose) that the extension of their restriction is non-empty. Still, there might be reasoners who employ PL in logical reasoning tasks.

6In AL, the logical compatibility of existential sentences with their universal counterparts implies that the inference in (1) is not an entailment (cf. footnote 2).

7Maybe problematically, N&G’s experiment instructions do not spell out what it means for a sentence (form) to logically follow from another one. Still, if the determiner some is a logical constant of English (see footnote 2) N&G’s result can be taken to show that only few subjects assigned the I-sentence its logical meaning, ∃x(Mx ∧ Kx).

8According to the grammatical view of SIs, the I-premise can entail the O-conclusion, namely if and only if the string some Ms are Ks is parsed with a covert exhaustification operator exh (Chierchia et al., 2012). This means that the grammatical view also holds that the indefinite determiner some is a logical constant of English and that its truth-condition content does not bring about the inference in (1) all by itself. Hence, since I-sentences can be parsed without exh, the inference from I- to O-sentences is not a logical entailment on the grammatical view either.

9The SI of the O-conclusion, viz. that its stronger universal counterpart all Ms are not Ks (≡ no Ms are Ks) is false, is entailed by the I-premise. Thus, the judgment whether the O-sentence logically follows from the I-sentence is not affected by the SI of the O-sentence.

10The letter A is the traditional name of universal affirmatives, i.e., sentences of the form all Ms are Ks. Universal negatives, i.e., sentences of the form no Ms are Ks will be designated by the letter e (see also §2).
(3) (A) All Ms are Ks
    (I) Some Ms are Ks

rejected by 27% of all subjects

In AL, A-to-I inferences are logically valid. However, the I-conclusion can only be drawn if its SI is not computed. Thus, the rejection rate of the A-to-I inference suggests that only a minority of reasoners computed the SI of the I-conclusion.¹¹

These observations raise the question of why the SI of an I-premise is computed more frequently than the SI of an I-conclusion, i.e., > 90% vs < 30% of all times.¹² Our answer will be based on the consideration that the locus or loci of SI computation characterize different types of reasoners, viz. the four types in Table 1, where the rows ±strong mark whether or not the SI of a premise is computed and conjunctively added to its literal meaning, and likewise for the columns and the conclusion. (Henceforth, instead of saying that the SI of a sentence is computed and conjunctively added to its literal meaning we simply say that the sentence is strengthened.)

<table>
<thead>
<tr>
<th>Conclusion</th>
<th>−strong</th>
<th>+strong</th>
</tr>
</thead>
<tbody>
<tr>
<td>Premise(s)</td>
<td>−strong</td>
<td>Logician Invalidator</td>
</tr>
<tr>
<td></td>
<td>+strong</td>
<td>Validator Strengthener</td>
</tr>
</tbody>
</table>

Table 1: Possible reasoner types by the loci of SI computation

Table 1 shows that we can hypothetically distinguish between four types of reasoners. These are reasoners that strengthen (i) neither premises nor conclusions (we call reasoners of this type Logicians), (ii) premises and conclusions (Strengtheners), (iii) premises but not conclusions (Validators), and (iv) conclusions but not premises (Invalidators). Reasoners of the first type are called Logicians because they only consider the logical relationships between the sentences of an argument. Strengtheners are so called because they strengthen all sentences of an argument. The name Validator alludes to the fact that reasoners of this type only strengthen premises, which can only lead to validation of the conclusion.¹³ Similarly, the name Invalidator relates to the fact that reasoners of this type strengthen the conclusion and only the conclusion, which can only lead to its invalidation.¹⁴

¹¹In PL, A-to-I inferences are not valid. Therefore, some of the rejections of the A-to-I inference might come from subjects that employ PL instead of AL. Importantly, even if there are PL reasoners, the fact that 73% of all subjects accepted the A-to-I inference shows that the large majority of subjects did not reject the A-to-I inference on logical grounds (i.e. they are not PL reasoners). Hence, if these subjects accepted the A-to-I inference on logical grounds (i.e. if they are AL reasoners) they did not compute the SI of the I-conclusion.

¹²There are other, perhaps more interesting questions that can be asked at this point. N&G raise the question of why reasoners interpret I-sentences in I-to-O inferences differently than in A-to-I inferences: “The paradox is that the same subjects who believe all implies some also believe that some implies the existence of negative instances!” (p. 539 in op. cit.) See §6, where we put this issue on the research agenda.

¹³That is, strengthened premises can entail a conclusion which is not entailed by the premises without their SIs.

¹⁴That is, the conclusion without its SI can be entailed by the premise but the strengthened conclusion may not be entailed.
We put forth the hypothesis that the observed variation in how frequently SIs are computed for premises vs conclusions is due to individual variation: there are different reasoning behaviors, i.e., different groups of reasoners.\textsuperscript{15} More specifically, we hypothesize that we encounter three groups of reasoners in logical reasoning studies:

\begin{enumerate}
\item The overall population consists of Logicians, Validators, and Strengtheners.
\end{enumerate}

Our hypothesis predicts that I-to-O inferences are accepted by two groups of reasoners, namely by Validators and Strengtheners. Furthermore, it predicts that A-to-I inferences are rejected by just one group, namely by Strengtheners. Thus, it is supported by the observed variation.\textsuperscript{16}

To test the hypothesis in (4), we conducted an experiment in which subjects were asked to form a judgment about the logical validity of so-called syllogisms, i.e., arguments like those in (5) and (6), where the former is logically valid and the latter logically invalid.

\begin{align*}
(5) & \quad \text{(A)} \quad \text{All Ms are Ks} \quad \text{(A)} \quad \text{All Ms are Ks} \\
& \quad \text{(1)} \quad \text{Some Ps are Ms} \quad \text{(6)} \quad \text{(E)} \quad \text{No Ms are Ps} \\
& \quad \text{(1)} \quad \text{Some Ps are Ks} \quad \text{(0)} \quad \text{Some Ps are not Ks}
\end{align*}

The (in)validity of a syllogism can be affected by SI computation, and their greater complexity allows us to have more variety amongst our experimental items. More importantly, syllogisms can induce more response patterns than arguments with just one premise. Hence, they may yield evidence for all three groups hypothesized in (4) (see §4). The goal of our paper is threefold: (i) to present analytical tools that help quantify the impact of SIs on syllogistic reasoning performance, (ii) to show how these tools can be used to experimentally establish the existence of specific groups of reasoners, and (iii) to discuss to what extent an experiment that we conducted succeeded in doing so.

The paper is structured as follows. We begin with a brief review of (Aristotelian) syllogisms (§2). We then identify six syllogism classes that differ from each other in how SI computation affects (or doesn’t affect) their (in)validity (§3). We proceed by spelling out the predictions of the hypothesis that there are three different groups of reasoners, viz. Logicians, Strengtheners, and Validators. That is, we show what response profiles we predict to observe given our

\textsuperscript{15}Note that this is not the only possible answer. Other researchers correlate error rates in logical reasoning tasks with processing complexity (e.g. Geurts 2003). Importantly, the processing complexity of a reasoning task is assumed to be the same for all reasoners. For instance, Geurts (2003) proposes a complexity measure assuming an “abstract reasoner.”

\textsuperscript{16}By being existentials, O-sentences also come with a SI, viz. the SI in (i).

\begin{itemize}
\item As expected, this SI also affects logical reasoning performance: N\&G report that 83\% of all subjects accepted logically invalid O-to-I inferences. Again, this can be put down to the fact that the I-conclusion is entailed by the conjunction of the O-premise and its SI. Moreover, it can again be hypothesized that SI computation can lead to rejection of a logically valid inference: in N\&G’s experiment, E-to-O inferences (i.e., inferences from no Ms are Ks to some Ms are not Ks), which are valid in AL, were rejected by 31\% of all subjects, presumably because of the SI in (i). Note that more reasoners accepted O-to-I inferences than reasoners rejected E-to-O inferences, as predicted by the hypothesis in (4): the former are accepted by Strengtheners and Validators, while the latter are only rejected by Strengtheners.
\end{itemize}
syllogism classes and these reasoner groups (§4). We then describe the experiment that we conducted and discuss its results (§5). We end with a conclusion and an outlook (§6).

2. Syllogisms

As exemplified in (5) and (6) above, syllogisms are arguments that are made up of three sentences, i.e., two premises and a conclusion. The linguistic form of the sentences of a syllogism as well as their arrangement is subject to restrictions.\(^17\) Every sentence must have one of the following four form types, traditionally called A, I, E, O: (A) all \(\alpha\) are \(\beta\); (I) some \(\alpha\) are not \(\beta\); (E) no \(\alpha\) are \(\beta\); (O) some \(\alpha\) are not \(\beta\) (where \(\alpha\) and \(\beta\) are predicate expressions, henceforth terms). The distribution of terms in a syllogism is restricted by two constraints: (i) there is one and only one term – the so-called middle term – that occurs in both premises (in (5) and (6), the term \(M\)); (ii) the unique term of the 2\(^{nd}\)/1\(^{st}\) premise is the (linearly) 1\(^{st}/2^{nd}\) term of the conclusion. Constraint (i) allows four distributions of terms, traditionally called figures: 1. the middle term is the 1\(^{st}/2^{nd}\) term of the 1\(^{st}/2^{nd}\) premise; 2. the middle term is the 2\(^{nd}\) term of both premises; 3. the middle term is the 1\(^{st}\) term of both premises; 4. the middle term is the 2\(^{nd}\)/1\(^{st}\) term of the 1\(^{st}/2^{nd}\) premise; for all four cases, constraint (ii) uniquely determines the term distribution in the conclusion. The four figures are graphically represented in (7). The colored boxes represent the terms, which means that blue boxes represent the middle term.

\[
\begin{align*}
\text{(7)} & \hspace{1cm} \begin{array}{cccc}
\cdots & \cdots & & \cdots \\
\text{Figure 1} & \text{Figure 2} & \text{Figure 3} & \text{Figure 4}
\end{array}
\end{align*}
\]

Consequently, there are 256 syllogisms: 4 sentence types (A, I, E, O) to the exponent of 3 (2 premises + 1 conclusion) \(\times\) 4 figures. Syllogisms are identified by giving, in this order, the form type of the 1\(^{st}\) premise, the form type of the 2\(^{nd}\) premise, the figure, and the form type of the conclusion. Thus, (5) is an instance of AI1I and (6) an instance of AE3O.

Of the 256 syllogisms, 24 are valid in AL, and 15 of those are also valid in PL. Valid syllogisms have at least one universal (A or E) premise. The nine syllogisms that are valid in AL but not PL have two universal premises and an existential (I or O) conclusion.\(^18\) There are five valid syllogisms with a universal conclusion, which can only be validated by universal premises.\(^19\) Finally, there are ten valid syllogisms with an existential premise and an existential conclusion.\(^20\) As we will show in §3, the distribution of existential sentences in a syllogism determines its membership in the syllogism classes that we use to test the hypothesis in (4).

\(^{17}\)We adopt the traditional restrictions from Aristotelian-scholastic logic to make our experimental results more easily comparable with the results of previous studies (e.g. Rips 1994). We agree with Geurts (2003) that these restrictions are mostly arbitrary and hence not particularly interesting from a logical or linguistic point of view.

\(^{18}\)These are AA1I, AA3I, AA4I, AE2O, AE4O, EA1O, EA2O, EA3O, and EA4O.

\(^{19}\)These are AA1A, AE2E, AE4E, EA1E, and EA2E.

\(^{20}\)These are AI1I, AI3I, IA3I, IA4I, AO2O, OA3O, EI1O, EI2O, EI3O, and EI4O.
3. Syllogism classes

We now detail how the ways that SIs can affect the (in)validity of syllogisms define syllogism classes, which form the conditions of our syllogism experiment. We can identify six syllogism classes by how their members are affected by SI computation. The classes are designated by $+v$ if their members are valid in AL, and by $-v$ otherwise. This designation is followed by $\sim v$, $\sim -v$, or $\sim \pm v$, depending on the effect of SI computation (see below for details). An important outcome of this classification is shown in Table 2. The table foreshadows which reasoner groups of hypothesis (4) are predicted to accept the syllogisms of which of the six classes as valid.

<table>
<thead>
<tr>
<th>Effect of SI computation</th>
<th>Validity status in AL</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\sim v$</td>
<td>$0$</td>
</tr>
<tr>
<td>$\sim -v$</td>
<td>Validators</td>
</tr>
<tr>
<td>$\sim +v$</td>
<td>Strengtheners</td>
</tr>
<tr>
<td>$\sim \pm v$</td>
<td>Validators</td>
</tr>
</tbody>
</table>

Table 2: Which groups are predicted to accept which classes

That is, the designations of the syllogism classes also inform about the mappings from validity in AL to the predicted validity judgments of the reasoner groups of hypothesis (4) (see §4).

There are two invariant classes, i.e., classes whose members are unaffected by SI computation:

- $[\sim v \sim -v]$ **Invariantly invalid syllogisms**

The syllogisms in this class are not validated by applying SI computation to their premises. There are three possible reasons for this: (i) SI computation is vacuous (syllogisms without existential premises, e.g. EE3I), (ii) SI computation isn’t vacuous but the conclusion can only be validated by two universal premises (syllogisms with a universal conclusion, e.g. IE4E), or (iii) SI computation isn’t vacuous but the premises are too weak for the SIs to be able to add enough strength to validate the conclusion (syllogisms with two existential premises, e.g. II4I, OO4I).

21 There is another kind of non-logical inference that is known to drastically impede logical reasoning performance, viz. illicit conversion (IC). By IC, the two terms of an A- or O-sentence are interchanged, see (i).

(i) a. all Ms are Ks $\sim c$ all Ks are Ms
   b. some Ms are not Ks $\sim c$ some Ks are not Ms

Note that neither the conversion of the terms of an A-sentence, (ia), nor the conversion of the terms of an O-sentence, (ib), is logically valid (hence the qualification illicit). We controlled for this influence on reasoning performance by excluding all syllogisms whose (in)validity is affected by IC. For example, we excluded the logically invalid syllogism AE3O in (6) because it is validated by the IC inference of the A-premise. To give an example of the opposite case, we excluded EI1O because the IC inference of the O-conclusions invalidates this logically valid syllogism.
Invariantly valid syllogisms

The syllogisms in this class are not invalidated by applying SI computation to the conclusion. There is only one possible reason for this: SI computation is vacuous because the conclusion is a universal sentence (AA1A, AE2E, AE4E, EA1E, EA2E).

Furthermore, there are four variant classes, i.e., classes whose members are affected by SI computation:

- $[-v \rightsquigarrow +v]$ Invalid syllogisms that are validated by SI computation
  
  Since universal conclusions can be only be validated by universal premises, class $[-v \rightsquigarrow +v]$ can only contain syllogisms with an existential (I or O) conclusion. However, the SI of the existential conclusion must also be validated by the (strengthened) premises, or else SI computation does not necessarily lead to validation. This means that the members of $[-v \rightsquigarrow +v]$ must be counterparts of a pair of valid syllogisms that differ only in that one contains I-sentences in places where the other contains O-sentences. There is one (and only one) such pair: IA3I and OA3O. This means that $[-v \rightsquigarrow +v]$ has the following two members (and only these two members): IA3O and OA3I.

- $[+v \rightsquigarrow +v]$ Valid syllogisms that are invalidated by SI computation
  
  This class contains all valid syllogisms with an existential conclusion (e.g. EI1O), except for the two members of class $[+v \rightsquigarrow \pm v]$ (see below).

- $[-v \rightsquigarrow \pm v]$ Invalid syllogisms that are validated by selective SI computation
  
  Here, “validated by selective SI computation” means that the members of $[-v \rightsquigarrow \pm v]$ are validated by the strengthened premises but only if the SI of the conclusion is not computed. The class contains invalid syllogisms with an existential premise and an existential conclusion (AO1I, AO3I, OA4I, EO1O, EO2O, EO3O, EO4O). To be a member of $[-v \rightsquigarrow \pm v]$, an invalid syllogism must have a valid counterpart in which the existential premise is replaced by its subcontrary (e.g. AI1I for AO1I).

- $[+v \rightsquigarrow \pm v]$ Valid syllogisms that are invalidated by selective SI computation
  
  This class contains valid syllogisms with an existential conclusion and an existential premise such that (i) the strengthened conclusion is not entailed by the premises and (ii) the strengthened conclusion is entailed by the SI of the existential premise in conjunction with the other premise. Class $[+v \rightsquigarrow \pm v]$ has two members, namely IA3I and OA3O.\footnote{It can be easily seen that the SI of the I-conclusion of IA3I is entailed by the SI of the I-premise in conjunction with the A-premise: the SIs of the I-conclusion and I-premise are the corresponding O-sentences, and OA3O is a valid syllogism (and the other way around for OA3O).}
It can be easily verified that these six classes exhaust the set of syllogisms. However, in section 5.3 we will present refinements of this classification.

4. Predictions

In §1, we formulated the hypothesis that there are three groups of reasoners, which we named Logicians, Validators, and Strengtheners. Table 3 recapitulates how we characterize these groups. In addition to this, the table shows how the members of each group interpret existential premises and conclusions, and what effect this can have for the validity of an argument. Thereby, “weak” stands for the literal ‘some or all’ meaning of the existential quantifier some and “strong” for its ‘some and not all’ meaning, which is derived by conjunctively adding its SI to the literal meaning. The colors encode the relation between the locus of SI computation and the potential effect of the SI.

<table>
<thead>
<tr>
<th>Logicians</th>
<th>Validators</th>
<th>Strengtheners</th>
</tr>
</thead>
<tbody>
<tr>
<td>don’t compute SI s</td>
<td>compute SI s for premises but not for conclusions</td>
<td>compute SI s for premises and conclusions</td>
</tr>
<tr>
<td>Existential premise</td>
<td>weak</td>
<td>strong</td>
</tr>
<tr>
<td>Existential conclusion</td>
<td>weak</td>
<td>weak</td>
</tr>
</tbody>
</table>

Table 3: The three groups and their interpretation of existential sentences of an argument

With the assumption of these three groups of reasoners, we predict to observe three different response patterns in syllogistic reasoning experiments, which are given in Table 4. For obvious reasons, we predict that the validity judgments of Logicians directly reflect the logical validity of a syllogism. That is, they are predicted to accept (√) the syllogisms of all classes that are designated as valid ([+v...]), and to reject (χ) the syllogisms of all classes that are designated as invalid ([−v...]). Validators are predicted to accept the syllogisms of all classes that are designated as [+v...], [...] [[counter] +v], or [...] [counter] [±v] (valid or valid if SI computation applies (only) to the premises), and to reject all others. Finally, Strengtheners are predicted to reject the syllogisms of all classes that are designated as [...] [counter] [−v] or [...] [counter] [±v] (invariantly invalid or invalid if SI computation applies to the conclusion), and to accept all others.

5. Experiment and results

5.1. The experiment

To test the predictions of our approach, we conducted an experiment with 120 participants over Amazon Mechanical Turk. Since class [+v [SI] [±−v]] evokes the same responses as class [+v [SI] −v] for all three groups (see Table 4), we chose not to use tokens of class [+v [SI] [±v]] in the experiment. Each participant was asked to give 100 binary acceptability judgments for
20 tokens of each of the five selected syllogism classes. Participants were told that they will be presented arguments with two premises and a conclusion, and were instructed “to say whether the premises being true means that the conclusion must be true as well.” That is, we used a necessity statement and the intuitive notion of the truth of a sentence to evoke judgments about logical validity. The syllogism in (8) exemplifies the tokens that we used in our experiment.

(8) No Italians are miners
    All bikers are Italians
    No bikers are miners

For the three terms of the syllogism tokens, we used different nationalities, professions, and hobbies (above Italian, miner, and biker, respectively), without repetitions. Which of the three terms functioned as the middle term was always randomly determined. The experimental task was preceded by a practice session consisting of two arguments that were different in form from (Aristotelian) syllogisms. Participants received feedback to their responses in the practice session.

5.2. Results: acceptance rates

Table 5 shows the mean acceptance rates of the syllogisms of each class. The ordering of the table rows reflects how many groups are predicted to accept the syllogisms of the corresponding class.\footnote{Since we don’t make any predictions about the relative size of the groups, the order of the rows of class \([−v \mapsto +v]\) and \([+v \mapsto −v]\) with respect to each other is arbitrary.} The table furthermore shows which differences between the mean rates we predict with the hypothesis that there are Logicians (L), Validators (V), and Strengtheners (S): brackets of the right side of Table 5 connect certain pairs of rows; for each bracket (and transitively each connected sequence of brackets), we predict a higher mean acceptance rate for the class at the lower tip of the bracket than for the class at the upper tip.

\begin{table}
\centering
\begin{tabular}{|c|c|c|c|}
\hline
Syllogism class & Logicians & Validators & Strengtheners \\
\hline
\([−v \mapsto −v]\) & \(\times\) & \(\times\) & \(\times\) \\
\hline
\([−v \mapsto ±v]\) & \(\times\) & \(\checkmark\) & \(\times\) \\
\hline
\([−v \mapsto +v]\) & \(\times\) & \(\checkmark\) & \(\checkmark\) \\
\hline
\([+v \mapsto −v]\) & \(\checkmark\) & \(\checkmark\) & \(\times\) \\
\hline
\([+v \mapsto ±v]\) & \(\checkmark\) & \(\checkmark\) & \(\times\) \\
\hline
\([+v \mapsto +v]\) & \(\checkmark\) & \(\checkmark\) & \(\checkmark\) \\
\hline
\end{tabular}
\caption{The predicted reasoning patterns for the members of each group}
\end{table}
Since the judgments with respect to class $[-v \overset{SI}{\sim} -v]$ and $[+v \overset{SI}{\sim} +v]$ are not impeded by SI computation, the error rates of 19% false positives and 23.7% false negatives are the most immediate reflexes of true performance errors. The error rates show that there is no general positive response bias. Five of the six predictions marked in Table 5 are borne out. However, ANOVA and post-hoc tests show that the difference between the mean acceptance rate of class $[-v \overset{SI}{\sim} \pm v]$ and $[+v \overset{SI}{\sim} -v]$ does not reach significance. That is, our prediction that syllogisms of class $[+v \overset{SI}{\sim} -v]$ are accepted more often than syllogisms of class $[-v \overset{SI}{\sim} \pm v]$ because the former are accepted by Logicians and Validators, while the latter are only accepted by Validators, is not borne out.

5.3. Discussion

As was just pointed out, the difference between the mean acceptance rate of class $[-v \overset{SI}{\sim} \pm v]$ and $[+v \overset{SI}{\sim} -v]$ does not reach significance. On closer inspection, the reason for this is that there is too much variation in acceptance rates across the syllogisms in $[+v \overset{SI}{\sim} -v]$. For instance, the tokens of the type in (9) are accepted $\sim 80\%$ of all times, while the tokens of the type in (10) are only accepted $\sim 50\%$ of all times.

As can be easily seen, the latter syllogisms are only valid in AL, while the former are valid in both AL and PL. That is, we observe that in $[+v \overset{SI}{\sim} -v]$ syllogisms that are valid in both AL and PL are accepted more often than syllogisms that are only valid in AL.26,27

Note also that we excluded syllogisms whose (in)validity is affected by IC inferences (see footnote 21).

Recall that all syllogisms with two universal premises and an existential conclusion, such as AE40 and EA30, are invalid in PL and that all syllogisms that are valid in PL are also valid in AL.

We did not collect the information whether a participant had training in formal logic. However, Rips (1994) notes that the subjects of his and Jeffrey Schank’s experiment were “20 University of Chicago students, none of whom had taken a course in logic.” Importantly, the data set of Rips (1994) also suggests that a syllogism’s validity in PL is a relevant factor for the acceptance rates within class $[+v \overset{SI}{\sim} -v]$: syllogisms in $[+v \overset{SI}{\sim} -v]$ that are valid in both AL and PL were accepted 68% of all times and syllogisms in $[+v \overset{SI}{\sim} -v]$ that are only valid in AL 51% of all times.

One might think that this result is expected since Rips (1994) already notes that “subjects gave 85.8% “follows”

<table>
<thead>
<tr>
<th>Class</th>
<th>L</th>
<th>V</th>
<th>S</th>
<th>% acc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>$[-v \sim -v]$</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>19</td>
</tr>
<tr>
<td>$[-v \sim \pm v]$</td>
<td>X</td>
<td>✓</td>
<td>X</td>
<td>56.4</td>
</tr>
<tr>
<td>$[-v \sim +v]$</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>64.6</td>
</tr>
<tr>
<td>$[+v \sim -v]$</td>
<td>✓</td>
<td>✓</td>
<td>X</td>
<td>60.7</td>
</tr>
<tr>
<td>$[+v \sim +v]$</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>76.3</td>
</tr>
</tbody>
</table>

Table 5: Mean acceptance rates and predicted differences
Another distinction that we overlooked in the design of our experiment is whether or not the sentences of a syllogism are inconsistent (before or after strengthening). Taking inconsistency into account leads to the following subclassifications of the classes identified in §3, where the designation \(-c\) stands for ‘inconsistent’:

- **Subclass \([-v \overset{S_1}{\rightarrow} -c]\) of \([-v \overset{S_1}{\rightarrow} v]\)**

  Class \([-v \overset{S_1}{\rightarrow} -c]\) contains syllogisms with the following properties: the SI of one of its premises in conjunction with the other premise entails the contradictory of the conclusion. The syllogisms in this class (e.g. A12A) have a valid syllogism as a counterpart which expresses the problematic entailment.\(^{28}\)

- **Subclass \([-c]\) of \([-v \overset{S_1}{\rightarrow} v]\)**

  This class contains syllogisms that are formed from sets of inconsistent sentences, i.e., counterparts of valid syllogisms in which the valid conclusion is replaced by its contradictory (e.g. AA1O, which is the inconsistent counterpart of the valid syllogism AA1A).

- **Subclass \([+v \overset{S_1}{\rightarrow} -c]\) of \([+v \overset{S_1}{\rightarrow} v]\)**

  Class \([+v \overset{S_1}{\rightarrow} -c]\) contains all valid syllogisms with an existential (I or O) conclusion that have a valid counterpart in which the superaltern (A or E) is the conclusion (e.g. AA11, which has AA1A as a counterpart; the SI of the I-conclusion of AA1I is the contradictory of the A-conclusion of AA1A).

The relevance of this subclassification for syllogistic reasoning studies can be seen from the fact that the rate of false positives is lower for class \([-v \overset{S_1}{\rightarrow} -c]\) and class \([-c]\) than for class \([-v \overset{S_1}{\rightarrow} v]\), where \([-v \overset{S_1}{\rightarrow} v]\) is now taken to exclude the syllogisms in the former two classes (i.e. the designation \(-v\) now stands for ‘invalid but consistent’). This is shown in Table 6.\(^{29}\)

<table>
<thead>
<tr>
<th>Class</th>
<th>% acc. in Rips (1994)</th>
</tr>
</thead>
<tbody>
<tr>
<td>([-v \overset{S_1}{\rightarrow} v])</td>
<td>10.3</td>
</tr>
<tr>
<td>([-v \overset{S_1}{\rightarrow} -c])</td>
<td>1.5</td>
</tr>
<tr>
<td>([-c])</td>
<td>1</td>
</tr>
</tbody>
</table>

Table 6: The effect of inconsistency on the rate of false positives

\(^{28}\)In the case of A12A, the valid counterpart is AO2O: its O-premise is the SI of the I-premise of A12A and its O-conclusion is the contradictory of the A-conclusion of A12A.

\(^{29}\)Our item set does not contain tokens of class \([-v \overset{S_1}{\rightarrow} -c]\) or \([-c]\). Therefore, we use the data of Rips (1994) in Table 6.
There are two possible explanations of the effect of inconsistency on the rate of false positives: (i) inconsistency leads to better recognition of invalidity; (ii) there are reasoners that do not form a judgment about logical consequence but about logical consistency (i.e. they check whether the conclusion is logically consistent with the premises).

We do not observe the same effect of inconsistency on false negatives. That is, as shown in Table 7 the rate of false negatives is not lower in class \([v \dashv \rightleftharpoons \neg c]\) than in class \([v \dashv \rightleftharpoons -v]\).\(^{30}\)

<table>
<thead>
<tr>
<th>Class</th>
<th>% acc. in our data</th>
<th>% acc. in Rips (1994)</th>
</tr>
</thead>
<tbody>
<tr>
<td>([v \dashv \rightleftharpoons -v])</td>
<td>53.4</td>
<td>51.3</td>
</tr>
<tr>
<td>([v \dashv \rightleftharpoons -c])</td>
<td>51.9</td>
<td>57</td>
</tr>
</tbody>
</table>

Table 7: The effect of inconsistency on the rate of false negatives

In the context of our hypothesis that there are Strengtheners, this result neither supports hypothesis (i) nor hypothesis (ii). For both syllogisms in \([v \dashv \rightleftharpoons -v]\) and syllogisms in \([v \dashv \rightleftharpoons -c]\), Strengtheners compute the SI of the conclusion. By hypothesis (i), they recognize the resulting invalidity of the logical consequence relation better for syllogisms in \([v \dashv \rightleftharpoons -c]\) than for syllogisms in \([v \dashv \rightleftharpoons -v]\). That is, by hypothesis (i) they are predicted to reject syllogisms in \([v \dashv \rightleftharpoons -c]\) more often than syllogisms in \([v \dashv \rightleftharpoons -v]\). By hypothesis (ii), some of the Strengtheners may form a consistency judgment instead of a judgment about logical consequence. Therefore, by hypothesis (ii) they are predicted to accept syllogisms in \([v \dashv \rightleftharpoons -v]\) more often than syllogisms in \([v \dashv \rightleftharpoons -c]\). Neither prediction is supported by the observed data. A possible explanation for the data in Table 7 is that the SI of an existential conclusion is (sometimes) not computed if the premises settle the stronger universal alternative (i.e. if they entail the universal alternative or entail its negation).\(^{31}\) In the case of the syllogisms in \([v \dashv \rightleftharpoons -c]\), the universal alternative is settled by the premises since they entail the contradictory of the SI of the conclusion, which is the negation of the universal alternative.

5.4. Results: identifying groups of reasoners

In this section, we illustrate how to determine whether the observed mean acceptance rates reflect homogeneous behavior within different groups and not heterogeneous behaviour of a single group (i.e. all subjects). Recall that every participant of our experiment gave a judgment about 20 tokens of each of the five selected syllogism classes. This means that for every participant we have a rich response profile by means of which we can detect consistent behavior

\(^{30}\)All of the syllogisms in class \([v \rightleftharpoons -c]\) are invalid in PL, since they have two universal premises and an existential conclusion. Therefore, the numbers for class \([v \rightleftharpoons -v]\) in Table 7 reflect only the acceptance rates of PL-invalid syllogisms. Our data set contains tokens of only one such syllogism. The apparent difference between the acceptance rate of the syllogism in \([v \rightleftharpoons -v]\) and the mean acceptance rate of class \([v \rightleftharpoons -c]\) is not significant.

\(^{31}\)According to Fox (2007), SI computation is motivated by the goal to reduce speaker ignorance inferences. If the premises of a syllogism settle the universal alternative of the conclusion, no speaker ignorance inference arises for this alternative and hence there is no motivation to derive the SI of the conclusion.
of individuals and similarities in behavior between individuals. To identify subpopulations in our data set, we used a density-based clustering algorithm, DBSCAN (Ester et al., 1996). With DBSCAN, a density cluster is defined by specifying what counts as a populated neighborhood of a data point (viz. by specifying how many data points must be minimally within a specified radius around that point). Density clusters consist of core points and border points. A data point is a core point if it has a populated neighborhood; a data point is a border point if it is in the neighborhood of a core point but not itself a core point; all other data points are outliers.

The behavior towards the two invariant classes, $[+v \overset{SI}{\leftrightarrow} +v]$ and $[-v \overset{SI}{\leftrightarrow} -v]$, gives a measure of a subject’s logical abilities. This measure can be used to gauge the subject’s behavior towards the three variant classes by how much it deviates from the subject’s logical abilities.

Since there are three variant classes, the subjects’ reasoning behavior towards the variant classes can be mapped into a three-dimensional coordinate space, which is shown in Figure 1. Perfect Logicians are mapped onto the front lower right corner. The distance from this corner along the three dimensions represents how much a subject deviates from a perfect Logician. Perfect Validators deviate maximally from perfect Logicians along two dimensions, the $x$-dimension, on which deviance towards class $[-v \overset{SI}{\leftrightarrow} +v]$ is represented, and the $z$-dimension, on which deviance towards class $[-v \overset{SI}{\leftrightarrow} \pm v]$ is represented. Perfect Strengtheners also deviate maximally from perfect Logicians along two dimensions, the $x$-dimension and the $y$-dimension, on which deviance towards class $[+v \overset{SI}{\leftrightarrow} -v]$ is represented. Other corners can also be characterized in terms of the reasoning behavior that a subject must have to be mapped onto that corner. The corner that is opposite of the Validators’ corner along all three dimensions is the Invalidators corner. Subjects in this corner compute $SI$s for conclusions but not for premises. The corner that is opposite of the Logicians’ corner is Mephistopheles’ corner. Like Mephistopheles, subjects in this corner always negate.

![Figure 1: The coordinate space into which the subjects’ reasoning behavior is mapped](image)
In Figure 2 and Figure 3, we show the inhabited coordinate space, i.e., the space onto which all subjects with an error rate of $\leq 12.5\%$ relative to the invariant classes are mapped ($\approx$ half of all subjects).

![Figure 2: The inhabited coordinate space](image)

The figures show that there are two density clusters (determined by DBSCAN), which are marked in red and green (outliers are black). The Logicians’ corner is a border point of the green cluster (i.e., it is in the neighborhood of a core point of the green cluster but not itself a core point). This means that the subjects that belong to the green cluster can count as Logicians. Similarly, the Validators’ corner is a core point of the red cluster. Hence, the subjects that belong to the red cluster can count as Validators.\(^{32}\) The two perspectives provided by Figure 2 and Figure 3 show that the Strengtheners’ corner is not populated and neither is any other corner. This means that there is no evidence for populations other than Logicians and Validators. Note that Figure 3 shows that almost all subjects are above the zero point of the $z$-axis and Figure 3 shows that almost all subjects are left of the diagonal of the base square of the cube. This means that almost all subjects strengthen conclusions sometimes. However, we don’t observe systematic strengthening of conclusions, i.e., there are no Strengtheners.

In a certain sense, our data do not contain a lot of noise: as the result of DBSCAN shows our data set contains only few outliers. However, we still need to be concerned about the quality of the data since the clusters that we can identify and associate with specific reasoning behaviors are very spacious. That is, the large majority of points are very distant from the corners that represent the reasoning behaviors that we hypothesized to exist. This means that only a small

\(^{32}\)Since the number of density clusters and their size depend, by design, on the parameter settings that determine what counts as a populated neighborhood, different parameters would have produced different results. The point of our demonstration is to show that there are parameters that determine two clusters that we can identify with two reasoner groups of hypothesis (4). Importantly, there is no parameter setting that would give us the group of Strengtheners of the group of Invalidators.
proportion of subjects showed the hypothesized behaviors consistently. We think that this is a consequence of the experimental design (primarily the length of the experiment).

6. Conclusion and outlook

We have presented a classification of syllogisms that allows to quantify how frequently the premises and/or the conclusion of a syllogism is strengthened by SI computation. Furthermore, we have put forward the hypothesis that there are three groups of reasoners, viz. Logicians, Validators, and Strengtheners, whose reasoning behavior is characterized in terms of the loci of SI computation in logical arguments. In this way, we could argue that the variation in error rates observed across syllogisms is an effect of individual variation: members of different reasoner groups form the same judgment for the syllogisms of some classes and different judgments for the syllogisms of other classes. The experimental results that we presented support this hypothesis to a certain extent. For instance, the assumption that there is a group of Strengtheners makes correct predictions for the mean error rates of certain classes. Problematically, though, there is no further evidence for the hypothesized group of Strengtheners. That is, our data set contains no cluster of response patterns that can be identified with the response pattern of an idealized Strengthen. Importantly, however, we did find this kind of evidence for the two other groups, viz. for the groups of Logicians and Validators.

In future research, we want to address two issues: (i) There is evidence that suggests that some reasoners employ PL in syllogistic reasoning tasks. This behavior raises the question under what circumstances these reasoners associate natural language quantifiers with non-Aristotelian meanings. Answering this question will inform us about the nature of the requirement that ensures the Aristotelian property of (strong) natural language quantifiers, i.e., the requirement that the restriction of a quantifier be non-empty. (ii) The reasoning behavior of Validators shows

Figure 3: Another perspective on the inhabited coordinate space
the preferred locus for SI computation in logical arguments, viz. the premises of an argument. We want to answer the question whether such a preference can also be found in other suprasentential contexts, and if so, how these contexts can be characterized. This will inform us about the reason why Validators employ SI computation selectively and hence inform about the motivation for SI computation being employed in natural language discourse.

References


A Comparison of fei and aber¹
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Abstract. This paper compares the modal particle fei (Schlieben-Lange, 1979; Thoma, 2009) with the modal particle/sentence adverb aber (not to be confused with the conjunction aber, ‘but’). Intuitively, both items express some form of contrast and correction. We will show that both are special among discourse particles in the following sense: They make a contribution that is interpreted at a level distinct from the level where at-issue content (Potts, 2005) is interpreted, as is standard for modal particles (see Gutzmann, 2015 and the references therein). But more interestingly, they exclusively relate to propositions that have not entered the Common Ground via being the at-issue content of an assertion made by the addressee.

Keywords: discourse particles, assertions, at-issue content, presuppositions, conventional implicatures, conversational implicatures.

1. Introduction

In this paper we compare the Bavarian modal particle fei (Schlieben-Lange, 1979; Thoma, 2009), which does not have a direct counterpart in standard German, with the modal particle/sentence adverb aber (not to be confused with the conjunction aber, ‘but’), which exists in Bavarian as well as in standard German. Intuitively, both items express some form of contrast and correction. We will show that both are special among discourse particles in the following sense, however: They make a contribution that is interpreted at a level distinct from the level where at-issue content (Potts, 2005) is interpreted, as is standard for modal particles (see Gutzmann, 2015 and the references therein). But more interestingly, they exclusively relate to propositions that have not entered the Common Ground via being the at-issue content of an assertion made by the addressee.

Following Hinterwimmer (to appear), we assume that fei is used by the speaker to direct the addressee’s attention to a conflict between her own and the addressee’s beliefs that is not maximally prominent at the point where the sentence containing fei is uttered. Such a conflict would be maximally prominent if a proposition \( p \) entailing the negation of the proposition \( q \) denoted by the sentence with fei had been previously asserted by the addressee. After all, by asserting \( p \), the addressee has presented herself as believing \( p \) to be true and proposed to add \( p \) to the Common Ground (Stalnaker, 1978). It is thus evident to a speaker who believes a proposition \( q \) entailing the negation of \( p \) that the addressee believes not \( q \), and by asserting \( q \) it likewise becomes evident to the addressee that the speaker believes not \( p \). Consequently, the conflict between the addressee’s and her own beliefs can be assumed by the speaker to be

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obvious not only to her, but to her addressee as well as soon as she has asserted \( q \), and there is hardly any need to draw the addressee’s attention to it.

The situation is different whenever the speaker only infers on the basis of contextual information and/or general background knowledge that the addressee believes a proposition \( p \) entailing the negation of the proposition \( q \) he is about to assert, or when \( \neg q \) is entailed by a conventional or conversational implicature or a presupposition of a previous utterance by the speaker. In such a case, the addressee has not explicitly proposed to add \( p \) to the Common Ground, and the question of whether \( p \) is true is therefore not automatically maximally prominent at the point where the speaker is about to assert the proposition \( q \). Consequently, the conflict in beliefs does not automatically become maximally prominent as soon as the speaker has asserted \( q \). The addition of \( \text{fei} \) to a sentence denoting \( q \) in order to direct the addressee’s attention to that conflict is thus not superfluous.

This explains the distribution of \( \text{fei} \), which is as follows: First, \( \text{fei} \) cannot be added felicitously to a sentence denoting a proposition \( q \) in a situation where the addressee has previously asserted a proposition \( p \) which contradicts \( q \). Second, the addition of \( \text{fei} \) is perfectly felicitous when the speaker’s assumption that the addressee believes \( p \) is based on contextual information and/or general background knowledge, or when \( p \) is a conventional or conversational implicature or a presupposition of a previous utterance by the speaker.

The discourse particle/sentence adverb \( \text{aber} \), in contrast, requires there to be a proposition \( p \) entailing the negation of the proposition \( q \) denoted by the sentence with \( \text{aber} \) that is, on the one hand, prominent at the point where that sentence is uttered. On the other hand, \( p \) may likewise not be the at-issue content of a sentence previously uttered by the addressee. Consequently, \( \text{aber} \) behaves like \( \text{fei} \) in certain respects and can felicitously be added to a sentence denoting the proposition \( q \) whenever the speaker can infer on the basis of contextually salient information that the addressee believes a proposition \( p \) entailing \( \neg q \). In contrast to \( \text{fei} \), however, \( \text{aber} \) cannot be added to a sentence denoting the proposition \( q \) in the three following situations: (a) The information on the basis of which the speaker infers that the addressee believes \( p \) is not contextually salient, but only general background knowledge. (b) \( p \) is entailed by a conventional implicature of a previous utterance of the addressee. (c) \( p \) is entailed by a presupposition of a previous utterance of the addressee.

The paper is structured as follows. Section 2 introduces the data to be accounted for. Section 3 summarizes the analysis of \( \text{fei} \) proposed in Hinterwimmer (to appear). Our analysis of \( \text{aber} \) is presented in Section 4. Section 5 gives the conclusion.

2. Data

Consider the contrast between the felicity of \( \text{fei} \) and \( \text{aber} \) in Tom’s reaction in (1), on the one hand, and their infelicity in Tom’s reaction in (2), on the other. Since \( \text{aber} \), as already said in the introduction, exists in standard German as well as in Bavarian, where it is spelled out as \( \text{oba} \), all examples are given in Bavarian for ease of comparison. The modal particle \( \text{doch} \), which likewise exists in standard as well as in Bavarian German, has been included for comparison.

(1) Paula (wearing only a shirt): I geh spaziern.
I’ll go for a walk.
Tom: S’is (fei/oba/doch) saukoit draussn.
   It’s terribly cold outside.

(2) Paula: S’is goa ned koit drauss’n.
   It’s not cold at all outside.
Tom: (So a Schmarr’n!) S’is (#fei/#oba/doch) saukoit drauss’n.
   (What nonsense!) It’s terribly cold outside.

In (1), the proposition denoted by the sentence Tom utters contradicts a proposition which Tom can plausibly assume Paula to believe on the basis of her non-verbal behavior in combination with the sentence she utters – namely that it is not cold outside. If she believed otherwise, she would presumably not leave the house with the intention to go for a walk wearing only a shirt. In such a situation, not only **doch** but also **fei** and **oba** can be added felicitously. In (2), in contrast, Paula has explicitly asserted that it is not cold outside. In that situation, only **doch** and neither **fei** nor **oba** can be added felicitously. It thus seems to make a difference whether the addressee has previously asserted a proposition that contradicts the proposition denoted by the sentence with **fei** or **oba**, or whether it can only be inferred by the speaker that the addressee believes that proposition on the basis of a combination of verbal and non-verbal behavior. The modal particle **doch**, in contrast, seems to be insensitive to that difference.

Consider next the contrast between (3) and (4). In (3), the addition of **fei** or **oba** is presumably infelicitous for the same reason for which it was infelicitous in (2) – the addressee has previously asserted a proposition which contradicts the proposition denoted by the sentence containing the respective discourse particle/sentence adverb (these sentences will henceforth be called the **prejacent**s). In (4), in contrast, where the same proposition – namely that Otto has eaten the whole cake – has not been asserted, but rather conversationally implicated by the addressee’s immediately preceding utterance, both **fei** and **oba** can be added felicitously.

(3) Paula: Da Otto hod den ganzn Kuacha gessn.
   Otto has eaten the whole cake.
   Otto hasn’t eaten the cake. It was Maria!

(4) Paula: Da Otto is in da Kich gwen und da Kuacha is weg.
   Otto was in the kitchen and the cake is gone.
Tom: Da Otto hod den Kuacha fei/oba ned gessn. Das woa d’Maria.
   Otto hasn’t eaten the cake. It was Maria!

Taken together, the contrasts discussed so far could be taken to show that both **fei** and **oba** can only be added to a sentence denoting the proposition **p** if the speaker believes but does not know for sure that the addressee believes a proposition contradicting **p**. After all, it is one of the defining features of conversational implicatures that they can be cancelled, and inferences based on verbal combined with non-verbal behavior are usually defeasible as well. As soon as an interlocutor **x** has asserted a proposition **q**, in contrast, the other interlocutors know for sure that **x** at least presents herself as believing **q**, and in the absence of mind-reading abilities, that
is the strongest evidence that one can hope to get that $x$ believes $q$. But now consider the following contrasts.

(5) Paula: In Fronkreich gibts imma no an Kini.  
In France there is still a king.

Tom: (So a Schmarr’n.) In Fronkreich gibts (#fei/#oba/doch) koan Kini nemma.  
What nonsense! In France there is no king anymore.

(6) Paula: Da Kini von Fronkreich is a Depp.  
The king of France is an idiot.

Tom: In Fronkreich gibts (fei/#oba/doch) koan Kini nemma.  
In France, there exists no king anymore.

The infelicity of both $fei$ and $oba$ in Tom’s reaction to Paula’s statement in (5) is exactly what we would expect, given what we have said so far, since the proposition asserted by Tom contradicts the proposition asserted by Paula. What is unexpected, though, is the felicity of $fei$ in Tom’s reaction to Paula’s statement in (6): It is standardly assumed, following Strawson (1950) (see Elbourne, 2013 for an overview of the discussion), that by using the definite article the speaker presupposes the existence of a unique entity satisfying the predicate denoted by the respective NP. Consequently, Paula (wrongly) assumes the Common Ground to entail the existence of a unique king of France at the point at which she utters the sentence. Tom has therefore just as strong evidence that Paula believes there to be a king of France in the case of (6) as he has in the case of (5). Concerning $fei$, it is thus not tenable that its addition is infelicitous whenever the speaker knows that the addressee believes a proposition contradicting the proposition denoted by the prejacent. The addition of $oba$, in contrast, while not being quite as infelicitous as in (5), is at least awkward in (6) as well.

Let us turn to the contrast between (7) and (8) next.

(7) Paula: Da Chomsky is a berühmta Soziologe.  
Chomsky is a famous sociologist.

Tom: (So a Schmarr’n). Da Chomsky is (#fei/#oba/doch) koa Soziologe.  
What nonsense! Chomsky is no sociologist.

(8) Paula: Da Chomsky, a berühmta Soziologe, is a Anarchist.  
Chomsky, a famous sociologist, is an anarchist.

Tom: Da Chomsky is (fei/#oba/doch) koa Soziologe.  
Chomsky is no sociologist.

Again, the infelicity of $fei$ and $oba$ in Tom’s reaction to Paula’s utterance in (7) is unsurprising in light of the discussion so far. What is remarkable, however, is that $fei$ is fully felicitous in Tom’s reaction to Paula’s utterance in (8). After all, as far as the relation between the proposition denoted by Tom’s reaction and the proposition that Chomsky is a famous sociologist is concerned, the only difference between (7) and (8) is the following: In (7) that proposition is the at-issue content of Paula’s previous assertion, while in (8) it is a conventional implicature in the sense of Potts (2005). As shown by Potts (2005), nominal appositives such as a berühmta Soziologe (‘a famous sociologist’) in (8), appositive relative clauses, and
expressives belong to a special kind of linguistic content dubbed conventional implicatures. One of the defining features of conventional implicatures is that they, in contrast to ‘ordinary’ semantic content, and similar to presupposed content, are not affected by semantic operations such as negating and questioning: The sentences in (9a-b), for example, are not understood as negating or questioning that Jennifer is a great drummer, but only that she will join the band.

(9)  
a. Jennifer, who is a great drummer, will not join the band.
   b. Will Jennifer, who is a great drummer, join the band?

At the same time, and in contrast to presupposed content, conventionally implicated content is assumed by the speaker to be new to the addressee. Intuitively, the contrast between conventionally implicated and ‘ordinary’ asserted content, which Potts (2005) dubs at-issue content, is the following: Getting across the at-issue content is the main point of the respective utterance. It is thus explicitly put on the table by the speaker (see Farkas & Bruce, 2010), and the addressee is invited to at least implicitly accept the respective proposition, or otherwise reject it explicitly. Conventional implicatures, in contrast, constitute side remarks that do not really promote the conversation and are assumed to be uncontroversial by the speaker, i.e. the speaker expects the addressee to simply accept them. This intuition is formalized by Potts (2005) in the following way: At-issue and conventionally implicated content are assumed to be interpreted at separate levels that do not interact with each other. By uttering the opening sentence in (8), Paula thus makes two claims at the same time: that Noam Chomsky is an anarchist, and that Noam Chomsky is a famous sociologist. The two claims do not have the same status, though. While the first one is the main point of her utterance, and she invites Tom to at least implicitly accept or else reject it, the second one is just a side remark she assumes to be uncontroversial. Nevertheless, Tom does not have any more reason to doubt that Paula believes Chomsky to be a famous sociologist in (8) than in (7), where that proposition is the at-issue content of her assertion. The felicity of fei in Tom’s reaction in (8) thus provides further evidence that it is not the question of whether the speaker knows or only believes that the addressee believes a proposition contradicting the prejacent of fei that is at stake. The behavior of oba, in contrast, is less clear in this regard: While its addition to Tom’s reaction in (8) is certainly not as infelicitous as in (7), it is still awkward and clearly considerably less felicitous than the reaction with fei.

Interestingly, the reaction in (8) with oba becomes entirely acceptable once Paula’s utterance is addressed and acknowledged first.

(10) Paula: Da Chomsky, a berühmta Soziologe, is a Anarchist.

Chomsky, a famous sociologist, is an anarchist.

Tom: Aha / Wenn´st moanst... / Ja scho...
   Ok / If you think so... / Yes, okay, ...
   Da Chomsky is oba koa Soziologe.
   But Chomsky is no sociologist.

We assume that by his reaction Tom acknowledges Paula’s utterance and thus agrees to the respective content being added to the Common Ground. After Tom’s acknowledgement, all parts of Paula’s utterance have entered the Common Ground and are now equally prominent. And this seems to be the crucial difference that sets (10) apart from (8). We observe the same
pragmatic effect in (6), where Tom’s reaction can also be rescued by acknowledging the content of Paula’s utterance first.

(11) Paula: Da Kini von Fronkreich is a Depp.  
*The king of France is an idiot.*

Tom: Aha / Wenn’st moanst... / Ja scho...  
Ok / If you think so... / Yes, ok, ...

In Fronkreich gibts oba koan Kini nemma.  
*In France, there exists no king anymore.*

Note also that, unsurprisingly, the facts in (8) and (10) can be re-established with speech-accompanying gestures, which have been claimed to pattern exactly like appositives by Ebert & Ebert (2014).

(12) Paula: Des TRIANGLE_[Stoppschild] in der Müllerstroß ist nei.\(^2\)  
*The stop sign in Müllerstraße is new.*

Tom: Des is/Stoppschilder san (fei/#oba/#doch) ned dreieckad.  
*It is/Stop signs are not triangular.*

Again, adding an acknowledging phrase in Tom’s response to Paula’s remark makes *oba* felicitous.

*The stop sign in Müllerstraße is new.*

Tom: Aha / Wennst moanst... / Ja scho...  
Ok / If you think so... / Yes, okay, ...

Des is/Stoppschilder san oba ned dreieckad.  
*It is/Stop signs are not triangular.*

Consider now the following example, where *fei* and *oba* clearly part ways. Consider first the contrast between the felicity of *fei* in an out-of-the-blue utterance of (14) as compared to the infelicity of *oba*.

(14) Tom: Des neie Buach vom Kehlmann is (fei/#oba/#doch) spitze!  
*The new book by Kehlmann is great!*

Intuitively, for *fei* to be felicitous it is sufficient for Tom to have good reasons to believe on the basis of general background knowledge that his addressee would have expected the new book by Daniel Kehlmann to be not great (because she does not like the books by Daniel Kehlmann, for example, or believes that no great books are written anymore these days). Consequently, the addition of *fei* would be awkward if Tom knew his addressee to be a fan of Daniel Kehlmann, for example, or to have no opinion whatsoever regarding the books of Daniel Kehlmann. Concerning *oba*, in contrast, general background knowledge is not sufficient to license its use (and similarly for *doch*): Even in a context where the addressee is well known to hate the books by Daniel Kehlmann, the addition of *oba* to (14) leads to infelicity if the

\(^2\) We indicate that a gesture GEST occurs at the same time as a certain expression EXP by GEST_[EXP]. TRIANGLE denotes a gesture where the speaker iconically indicates a triangular object.
sentence is uttered out of the blue. Rather, for *oba* to be felicitous, the question of whether the new book by Daniel Kehlmann is great needs to have been raised at least implicitly in the preceding conversation. Additionally, just as with *fei*, the speaker needs to have good reasons to believe that the addressee would have expected the new book by Daniel Kehlmann to be not great. Consequently, both *fei* and *oba* are perfectly fine in Tom’s reaction to Paula’s utterance in (15).

(15) Paula: S’gibt oifäch koane gscheidn Biacha nemma.  
*There simply are no good books anymore.*
Tom: Des neie Buach vom Kehlmann is (fei/oba/doch) spitze!  
*The new book by Kehlmann is great!*

With this in mind, consider next the contrast between (16) and (17).

(16) Paula: Des neie Buach vom Kehlmann is spitze!  
*The new book by Kehlmann is great.*
Tom: Des is (#fei/#oba/doch) da letzte Schmarr’n.  
*It’s complete nonsense.*

(17) Paula: I find des neie Buach vom Kehlmann spitze!  
*I find the new book by Kehlmann great.*
Tom: Des is (#fei/oba/doch) da letzte Schmarr’n.  
*It’s complete nonsense.*

Again, the infelicity of both *fei* and *oba* in Tom’s reaction to Paula’s utterance in (16) is expected in light of our discussion so far, since the at-issue content of Paula’s utterance contradicts the at-issue content of Tom’s utterance. The infelicity of *fei* in Tom’s reaction to Paula’s utterance in (17) is likewise expected, since the at-issue content of that utterance entails that she believes a proposition that contradicts the prejacent of *fei* — namely that the new book by Daniel Kehlmann is no nonsense. What is surprising, however, is the felicity of *oba* in (17), which, given what we have said so far, should be infelicitous for the same reason as *fei*. In contrast to *fei*, *oba* only seems to be infelicitous when the addressee has previously asserted a proposition *p* that contradicts the prejacent, but not when she has asserted that she ‘finds’ *p*. When a speaker says that she finds *p*, this is a subjective judgment presented as an opinion and not a fact (for an analysis of German *finden* ‘find’, see among others Reis, 2013; Umbach, in press), which seems to matter for the felicity of Tom’s reaction with *oba* in (17).

Consider furthermore the following exchange between Paula and Tom.

(18) Paula: I woaß ned ob I ma des neie Buach üba d’Münchna Räterepublik kafa sui.  
*I don’t know if I should buy the new book about the Soviet republic of Munich.*
Tom: Des is (fei’/oba/doch) interesserant.  
*It’s interesting.*

In the case of (18), Paula’s utterance indicates that she believes neither the proposition denoted by Tom’s reaction nor its negation, i.e. she considers it both possible that the book is interesting and that it is not interesting – otherwise there would be no point in making the utterance in the
first place. In such a situation, the addition of *fei* is perfectly felicitous, while *oba* is degraded (although far from being infelicitous).

Our observations regarding the distribution of *fei* and *oba* can be summarized as follows.

(a) The distribution of *fei*:

*fei* can be added felicitously to a sentence denoting the proposition \( p \) in a context where the interlocutor either believes \( \neg p \) or at least considers \( \neg p \) to be a likely option and \( \neg p \)

(i) can be inferred from the context or general background assumptions, or

(ii) is entailed by the conversational or conventional implicatures or presuppositions of a previous utterance by the interlocutor.

The addition of *fei* is infelicitous, in contrast, if there is a previous utterance by the interlocutor whose at-issue content in combination with the fact that the interlocutor has asserted it entails that she believes \( \neg p \).

(b) The distribution of *oba*:

*oba* can be added felicitously to a sentence denoting \( p \) in a context where

(i) a proposition entailing \( \neg p \) is activated in the discourse,

(ii) it can be inferred that the addressee believes \( \neg p \),

(iii) there is no recent assertion \( A \) by the addressee such that the at-issue content of \( A \) entails \( \neg p \) and

(iv) neither the presuppositions nor the conventional implicatures of a recent utterance by the interlocutor entail \( \neg p \).

Having presented data that illustrates the differing felicity conditions of *fei* and *aber*, we will show in the following that the two particles sometimes also differ in their perlocutionary force.

(19) (Tom just sat down on a chair next to Melanie.)
Melanie to Tom: Do sitzt (*fei/oba/doch*) imma d’Miriam.
*This is where Miriam usually sits.*

All particles are licensed in (19). There is, however, a difference in what (19) pragmatically conveys depending on the particle used. While the utterance with *doch* is an allegation and indicates that Melanie is of the opinion that Tom should know about the fact that Miriam usually sits in this chair, with *fei* it has informational character and conveys that Melanie assumes that Tom does not know about this fact, fully in line with what we have argued so far about the semantics of *fei*. With *oba*, however, (19) turns into a demand for Tom to stand up and look for a different place to sit. In other words, while (19) with *fei* is an informational statement, with *oba* it is a demand.

Similarly, in the following example, adding *oba* turns the utterance into an implicit demand, while *fei* and *doch* do not.
(20) Child: Wos gibt’s zum Mittogessen?  
*What have you cooked for lunch?*

Mother: Lachs mit Spinat.  
*Salmon with spinach."

Child: I mog (fei/oba/doch) koan Spinat ned!  
*I don’t like spinach!"

With *oba*, the child implicitly asks his mother to prepare some alternative food for him, the utterances with *fei* or *doch* lack this connotation.

In Section 3, we will summarize and partially refine the analysis of *fei* argued for in Hinterwimmer (to appear), and in Section 4 we will present our analysis of *oba* and discuss how this analysis can account for the observed semantic behaviour of *oba* and its pragmatic effects.

3. The analysis of *fei*

*fei* is a modal particle that is derived from Latin *finis* and French *fin* (*end, border*) and entered Bavarian German in the 12th century (Schlieben-Lange, 1979; Glaser, 1999). As already said in the introduction, *fei* does not have a direct counterpart in standard German. Distributionally, it shares all the characteristics of modal particles (Weydt, 1969; Thurmail, 1989; Jacobs, 1991; Omelius-Sandblom, 1996; Zeevat, 2003; Karagjosova, 2004; Corniglio, 2011; Zimmermann, 2008; 2011; Gutzmann, 2015; see the papers in Bayer and Struckmeier, 2017 for a recent overview): It is always optional, it can only occur in the so-called middle field, it cannot receive the main accent of the respective clause, it cannot be questioned, it cannot be negated and it does not contribute to the truth conditions of a sentences containing it, i.e. a sentence with *fei* always has the same truth conditions as the corresponding sentence without *fei* (see Thoma, 2009 and Hinterwimmer, to appear for details). In descriptive linguistic work, *fei* is taken to add emphasis to the meaning of the sentence containing it. The first analysis of *fei* in modern linguistic terms has been proposed by Thoma (2009), and that analysis is also the starting point for the analysis proposed by Hinterwimmer (to appear).

Thoma (2009) assumes that *fei* is not only a modal particle, but also encodes polarity focus. The second part of this assumption is refuted in Hinterwimmer (to appear). For reasons of space, we cannot go into the details of that refutation here and have to refer the interested reader to Hinterwimmer (to appear). According to Thoma (2009), the felicity conditions of *fei* can be stated as follows: Adding *fei* to a sentence α with propositional content p is felicitous in a context C iff the speaker believes in C that the addressee believes ¬p. Based on the data discussed in Section 2, Hinterwimmer (to appear) shows that Thoma’s analysis, while capturing an essential component of *fei*’s felicity conditions, misses an important aspect – namely that *fei* is only felicitous if the speaker’s assumption that the addressee believes ¬p is inferred on the basis of contextually available information or general background knowledge, or if the conversational or conventional implicatures of a previous utterance by the addressee in combination with the fact that she has made that utterance entail that she believes ¬p. Whenever the at-issue content of a previous utterance by the addressee in combination with the fact that she has made that utterance entail that she believes ¬p, in contrast, the addition of *fei*
is infelicitous. Additionally, as shown by the felicity of fei in Tom’s reaction to Paula’s utterance in (18), repeated here as (21), the felicity conditions assumed by Thoma (2009) are too strong: The speaker need not believe that the addressee believes ¬p. Rather, it is sufficient that she believes the addressee to consider ¬p a likely option.

(21) Paula: I woaß ned ob I ma des neie Buach üba d’Münchna Räterepublik kafa sui.
     *I don’t know if I should buy the new book about the Soviet republic of Munich.*
Tom: Des is (fei’/oba/doch) interessant.
     *It’s interesting.*

In order to state the just-sketched felicity conditions precisely, it is crucial to have a clear definition of at-issue content as opposed to secondary, i.e. presupposed or conventionally implicated, content. Hinterwimmer (to appear) follows AnderBois et al. (2015) and Murray (2017) in assuming that at-issue content differs from conventionally implicated content in the way in which it enters the Common Ground: It is only the at-issue content that is asserted, where for a proposition to be asserted means that the speaker explicitly proposes to add it to the Common Ground. Crucially, the respective proposition is only added to the Common Ground after the addressee has explicitly or implicitly accepted it. From this it follows that it is entirely unproblematic for the addressee to directly deny or question an asserted proposition. For conventional implicatures, in contrast, there is no intermediate step, i.e. they enter the Common Ground directly. Consequently, the addressee cannot directly deny or question a conventional implicature, but rather has to employ special means that interrupt the flow of the conversation such as saying ‘Hey, wait a minute!’ first (Shannon, 1976; von Fintel, 2004). The same applies to presupposed content, which, even if it is not already part of the Common Ground, is at least treated by the speaker as if it was. Finally, since it is one of the defining features of conversational implicatures that they can be cancelled, it is clear that they are likewise not asserted.

With these assumption in place, the felicity conditions of fei can now be stated informally as given in (23). Note that the version in (23) differs from the one in Hinterwimmer (to appear) in the following respect: It is stated in such a way that it accounts for the infelicity of fei in cases where the addressee has asserted a proposition entailing ¬p as well as for the infelicity of fei in cases such as (17), repeated here as (22), which were not discussed in Hinterwimmer (to appear). In (22), the speaker has not asserted a proposition entailing ¬p, but rather a proposition entailing that she ‘finds’ ¬p. Condition (ii) is general enough to account for both cases: If the addressee has asserted a proposition entailing ¬p, then the fact that she has uttered that proposition entails that she believes ¬p, and if she has asserted a proposition entailing that she ‘finds’ ¬p, then the fact that she has uttered that proposition entails that she believes that proposition as well.

(22) Paula: I find des neie Buach vom Kehlmann spitze!
     *I find the new book by Kehlmann great.*
Tom: Des is (#fei/oba/doch) da letzte Schmarr’n.
     *It’s complete nonsense.*

(23) *fei* can be added felicitously to a sentence α denoting the proposition p in context C iff
     (i) the speaker believes that the addressee considers ¬p a likely option.
(ii) there is no recent assertion A by the addressee such that the content of A in combination with the fact that the addressee has asserted it entails that the addressee believes \( \neg p \).

This informal analysis (or rather, a close variant of it) is formally implemented in Hinterwimmer (to appear) in a possible worlds framework along the lines of Hintikka (1969). In such an analysis, a person \( x \) believes a proposition \( p \) in a world \( w \) iff \( p \) is true in all worlds \( w' \) that are compatible with what \( x \) believes in \( w \). In order to formalize the notion of considering a proposition a likely option, existential rather than universal quantification is required. Unrestricted existential quantification over the addressee’s belief worlds would be too weak, however, to formalize the first felicity condition in (23): This would predict \( fei \) to be felicitous whenever the speaker assumes that the addressee does not completely exclude the possibility that \( \neg p \) is true. Rather, what we need is existential quantification not over the entire set of the addressee’s belief worlds, but rather over the following subset: the set of worlds containing only those worlds that correspond to the addressee’s assumptions about what is stereotypically the case (cf. Kratzer’s, 1981 analysis of modal verbs).

Putting everything together, the informally stated felicity conditions can be formalized as in (24), which is paraphrased in (25).

(24) \( fei \) can be added felicitously to a sentence \( \alpha \) denoting the proposition \( p \) in context \( C \) iff

(i) \( \forall w \in DOX_{SP,w^*} [\exists w'' \in \text{MAX}_{\text{Stereo-ADR}}(DOX_{ADR, w})[\neg p(w'')]] \),

where \( SP \) is the speaker in \( C \), \( ADR \) is the addressee in \( C \), \( w^* \) is the world of \( C \), \( DOX_{SP,w^*} \) is the set of worlds compatible with what \( SP \) believes in \( w^* \), and \( \text{MAX}_{\text{Stereo-ADR}} \) is the function mapping a set of worlds to the subset that makes as many of \( ADR \)'s assumptions about what is stereotypically the case true as possible.

(ii) \( \neg \exists e[\text{Assertion}(e)(w^*) \land \text{Agent}(e, ADR) \land \text{recent}(\tau(e)) \land \text{Content}(e) = q \land \forall w \forall v \forall x[\text{Assertion}(e)(w) \land \text{Agent}(e, x) \land \text{sincere}(e, x) \land \text{Content}(e) = q \rightarrow \forall w \in \text{DOX}_{x,w} [\neg p(w)]] \).

(25) \( fei \) can be added felicitously to a sentence \( \alpha \) denoting the proposition \( p \) in context \( C \) iff

(i) all of the speaker’s belief worlds contain at least one world that is compatible with as many of the addressee’s assumptions about what is stereotypically the case as possible where the negation of \( p \) is true, and

(ii) there is no recent assertion of a proposition \( q \) by the addressee such that in all worlds where an individual \( x \) sincerely asserts \( q \), \( \neg p \) is true in all worlds that are compatible with what \( x \) believes in \( w \) (i.e. there is no recent assertion of a proposition by the addressee such that whenever someone asserts that proposition sincerely, she believes \( \neg p \)).

These felicity conditions account for all the facts discussed in Section 2. Concerning the question of why there should be a modal particle with such complex and subtle felicity conditions, the reasoning already sketched in the introduction applies: \( fei \) can be used by the
speaker to direct the addressee’s attention to a conflict between her own beliefs and the addressee’s beliefs that is not maximally prominent at the point where the sentence with fei is uttered. That is the case when the speaker’s assumption that the addressee at least considers a proposition contradicting the propositional content of the prejacent of fei to be a likely option is inferred on the basis of contextual information or general background knowledge. It is also the case if the presuppositions or conversational or conventional implicatures of a recent utterance by the addressee entail such a proposition. But consider the case when the addressee has asserted a proposition where it directly follows from her having asserted it sincerely that she believes a proposition contradicting the propositional content of the prejacent of fei. In this case, simply asserting the propositional content of the prejacent of fei would have been sufficient to make the conflict between the speaker’s and the addressee’s beliefs maximally prominent.

4. The analysis of oba

After having presented our analysis of fei, let us now return to oba, the Bavarian version of aber (‘but’) (recall that the only reason why we discuss the Bavarian instead of the standard German version is to facilitate comparison with fei – as far as we know, there are no relevant semantic or pragmatic differences between the two uses). As already said in the introduction, we are only interested in its uses as a speech act particle or sentence adverb in this paper, i.e. in those uses where it does not conjoin two clauses, but rather occurs after the finite verb in a sentence that is uttered as a reaction to a previous utterance of an interlocutor. Recall from Section 2 that oba, just as fei, (a) can be used if the speaker assumes the addressee to believe a proposition p that contradicts the proposition denoted by the prejacent and (b) cannot be used if the addressee has asserted a proposition that entails ¬p, but differs from fei in the following respects: First, it is at least awkward when a proposition entailing ¬p is presupposed or conventionally implicated by a previous utterance of the addressee (see (6) and (8), repeated here as (26) and (27), respectively, cf. also (12)). Second, it is not sufficient that the speaker believes on the basis of general background knowledge that the addressee believes ¬p. Rather, that the addressee believes ¬p has to be inferable on the basis of contextually salient information p (see (14) and (15), repeated here as (28) and (29), respectively). Finally, oba is felicitous when the addressee has previously asserted a proposition entailing that she ‘finds’ ¬p (see (16) and (17), repeated here as (30) and (31), respectively).

(26) Paula: Da Kini von Fronkreich is a Depp.  
*The king of France is an idiot.*

Tom: In Fronkreich gibts (fei/#oba/#doch) koan Kini nemma.  
*In France, there exists no king anymore.*

(27) Paula: Da Chomsky, a berühmta Soziologe, is a Anarchist.  
*Chomsky, a famous sociologist, is an anarchist.*

Tom: Da Chomsky is (fei/#oba/#doch) koa Soziologe.  
*Chomsky is no sociologist.*

(28) Tom: Des neie Buach vom Kehlmann is (fei/#oba/#doch) spitze!  
*The new book by Kehlmann is great!*
_There simply are no good books anymore._
Tom:  Des neie Buach vom Kehlmann is (fei/oba/doch) spitze!  
_The new book by Kehlmann is great!_

(30) Paula: Des neie Buach vom Kehlmann is spitze!  
_The new book by Kehlmann is great._
Tom:  Des is (#fei/#oba/doch) da letzte Schmarr’n.  
_It’s complete nonsense._

(31) Paula:  I find des neie Buach vom Kehlmann spitze!  
_I find the new book by Kehlmann great._
Tom:  Des is (#fei/oba/doch) da letzte Schmarr’n.  
_It’s complete nonsense._

While there are various analyses of the English equivalent of _aber/oba_, but (see, e.g., Lakoff, 1971; Winter and Rimon, 1994; Umbach, 2005), the use of _aber/oba_ as a sentence adverb of speech act particle has received rather little attention (but see Kwon, 2005 and the references therein). As we will now show, the felicity conditions of _aber/oba_ just repeated can be captured in a way that is in large parts very similar to our analysis of _fei_, but also differs from it in certain relevant aspects.

(32)  _aber_ can be added felicitously to a sentence _α_ denoting the proposition _p_ in context _C_  
if  
(i) a proposition _q_ entailing _¬p_ is salient and _q_ is one of the possible answers to the current _question under discussion (QUĐ)_ with _p_ entailing another possible answer.  
(ii) there is no recent assertion _A_ by the addressee such that the at-issue content of _A_ entails _¬p_.

The condition in (32ii) is closely related to the second felicity condition of _fei_ stated formally in (24ii) and informally in (23ii), with one crucial difference: According to (23ii)/(24ii), what is disallowed is the existence of a recent assertion such that the propositional content of the assertion in combination with the fact that the addressee has made that assertion entails that she believes _¬p_. That formulation captures the observation that _fei_ is infelicitous not only in cases such as (30), where the addressee has asserted a proposition entailing _¬p_ – in that case, that the new book by Daniel Kehlmann is not nonsense –, but also in cases such as (31), where she has asserted a proposition entailing that she ‘finds’ _¬p_. The condition in (32ii), in contrast, is formulated in such a way that it allows cases of the latter kind,3 and only disallows cases of the former kind.

3 Note that Umbach (in press) argues that ‘subjective judgments [such as the complements of _finden_ ‘find’] present their propositions as mere opinions, not intended to enter the common ground’ (Umbach, in press: 28 of final draft). As they are not intended to enter the common ground, they do not open up new issues for discussion, i.e. they do not affect the table. This would mean that, according to Umbach, they do not raise any QUDs, which in turn would mean that _oba_ should not be licensed in a reaction to subjective statements as in (30), contrary to what we find. Our analysis is, however, in line with Reis (2013), who proposes that _finden_ ‘find’ triggers the presupposition that there is an open issue that is under debate. In other words, there is a QUD that is presupposed by using the word _finden_ ‘find’. We assume that it is this QUD that is addressed by the reaction with _oba_ in (31).
The condition in (32i) differs more fundamentally from the one in (23i)/(24i). It captures both the infelicity of *oba/aber* in cases such as (28) and its felicity in case such as (29), and the observation that *oba*, in contrast to *fei*, is infelicitous if the presuppositions or conventional implicatures of a previous assertion by the addressee entail ¬p. The crucial point is the requirement that both the prejacent p and the contextually salient proposition q entailing ¬p constitute possible answers to the *current question under discussion* (QUD). This notion goes back to Roberts (1996; see Klein and von Stutterheim, 1987; van Kuppevelt, 1995 for similar views) and is based on the following idea: It is not only utterances in oral conversations that answer explicit or implicit questions, but also sentences in all kinds of written texts. In cases where the QUD is implicit, the task of the addressee/reader is to identify the QUD that the respective sentence answers on the basis of its focus-background structure, where the explicitly given or inferable parts correspond to the background and the new parts to the focus: The focal part replaces the wh-term contained in the implicit QUD, thus picking one from the set of possible answers. The given or inferable material, the background, in contrast, corresponds to the remaining part of that subquestion.

Now, the assumption that the contextually salient proposition contradicting the prejacent of *oba* has to be a possible answer to the current QUD automatically rules out cases where the propositional content of the prejacent of *oba* contradicts the presupposition of a previous utterance of the addressee, as in (26): Being presupposed and thus at least being treated as if it was already part of the Common Ground by the one who utters the respective sentence, a presupposed proposition can by definition not answer the QUD (which, in the case of (26) can only be a question such as *What is the king of France like?*, but not a question such as *Is there a king in France?*). Simons et al. (2010) (see also Beaver et al., 2017) show, based on contrasts like the one between (33) and (34), that also conventional implicatures, in contrast to the at-issue content of a sentence, can never answer the current QUD:

(33)  Tom: Where did Mary buy her new dress?
      Susan: Mary, who lives in Potsdam, bought it at a store in Berlin.
      Susan: #Mary, who bought it at a store in Berlin, lives in Potsdam.

(34)  Tom: Where does Mary live?
      Susan: Mary, who bought her new dress at a store in Berlin, lives in Potsdam.
      Susan: #Mary, who lives in Potsdam, bought her new dress at a store in Berlin.

The felicity conditions stated informally in (32) above and stated more formally in (35) thus successfully capture the distribution of *aber/oba*.

(35)  *aber/oba* can be added felicitously to a sentence α denoting the proposition p in context C iff

(i) ∃q[∀w[q(w) → ¬p(w)] ∧ prominent(q, time(C))] ∧ q ∈ QED\textsubscript{time(C)} ∧ ∃r ∈ QU\textsubscript{time(C)}[∀w[p(w) → r(w)]],

where QU\textsubscript{time(C)} is the question under discussion at the time of C.

(ii) ∃e[Assertion(e)(w*) ∧ Agent(e, ADR) ∧ recent(τ(e)) ∧ Content(e) = q ∧ ∀w[q(w) → ¬p(w)]].
It would be worth pursuing the relation between the conjunction uses of *oba/aber* and its uses as a discourse particle. Interestingly, Umbach (2005) proposes an analysis of the conjunction *but* which is also based on the notion of QUD. Very roughly, and simplifying considerably, she assumes that *but* is felicitous iff each of the two clauses conjoined by *but* answers one of two polar questions serving as the subquestions of an (usually implicit) superquestion, with one of the two questions being answered positively and the other negatively. Further investigating the relation between our analysis of *oba/aber* as a sentence adverb or discourse particle and Umbach’s (2005) analysis of the conjunction *but* is a topic that we have to leave for future research.

We will now turn to the perlocutionary acts of utterances with *aber/oba* and *fei*, i.e. examples (19) and (20), repeated here as (36) and (37).

(36) (Tom just sat down on a chair next to Melanie.)
Melanie to Tom: Do sitzt (fei/oba/doch) imma d’Miriam.
*This is where Miriam usually sits.*

(37) Child: Wos gibt’s zum Mittogessen?
*What have you cooked for lunch?*
Mother: Lachs mit Spinat.
*Salmon with spinach.*
Child: I mog (fei/oba/doch) koan Spinat ned!
*I don’t like spinach!*

The pragmatic effect of the *oba*-reaction in (36) directly follows from our analysis that *oba* is licensed only if the corresponding utterance addresses a current QUD. In case of (36), there is no explicit preceding discourse and thus no obvious QUD. By sitting down on the chair next to Melanie, there is, however, an implicit question that is raised, namely whether this seat is taken or not and whether Tom is allowed to sit there or not. It is this question that is addressed by Melanie’s reaction and answered negatively. This is why the reaction in (36) with *oba* is understood as an implicit demand to change seats. With *fei*, on the other hand, there is no implicit QUD that needs to be addressed. The fact that Tom sat down on Miriam’s place simply indicates that he apparently believes this seat is not taken (in general and not taken by Miriam in particular), which licenses the utterance with *fei*.

As for (36), the reasoning is parallel. As the semantics of *oba* requires that there is a QUD that is addressed by the corresponding utterance, the child’s reaction with *oba* triggers a presupposition that there is such a QUD. In case of (37) it would most sensibly by a question such as *Do I like this?* or *Can I eat this?* as a follow-up to *What have you cooked for lunch?*. The child’s reaction with *oba* would then be interpreted as answering the question whether what the mother prepared for lunch is something that he likes or can eat, indicating that the answer is *no*. Hence, the reaction receives the character of a demand to the mother to prepare something different for the child. Again, with *fei*, there is no such connotation, because an utterance with *fei* does not have to address a current QUD.
5. Conclusion and outlook

In this paper we have compared the felicity conditions of the Bavarian discourse particle fei and the sentence adverb or modal particle oba/aber.

One issue we have not addressed and which is still an open question is why oba/aber is licensed and used very frequently in reactions to demands or requests.

(38) Mother: Du sollst deine Hausaufgaben machen.
    You have to do your homework.
  Child: Ich mach aber keine Hausaufgaben!
    I won’t do my homework!

It is not clear whether imperatives can be taken to induce QU Ds and, if so, which ones. One could speculate that they trigger the QU D of whether the addressee does what is demanded or not (see Gutzmann, 2012: 99). If that is the case, this would explain why the reaction in (38) is fully acceptable – it addresses the QU D whether the child will obey and answers it negatively.

We leave a comprehensive analysis of aber/oba in reactions to imperatives for future research.

References


QUD effects on epistemic containment principle: An experimental study
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Abstract. The Epistemic Containment Principle (ECP) requires that epistemic modals take wider scope than strong quantifiers such as every or most (von Fintel and Iatridou, 2003). Although fairly robust in its realization, a few systemic classes of counterexamples to the ECP have been noted. Based on these, previous work has argued for two claims: subjective modals obey the ECP, whereas objective ones don’t (Tancredi, 2007; Anand and Hacquard, 2008); and every respects the ECP, whereas each violates it (Tancredi, 2007). This paper argues that explicit Questions Under Discussion (QUDs; Roberts, 1996; Ginzburg, 1996) also systematically influence the ECP: scopal orderings that provide relevant answers to the given QUDs are preferred, and this tendency can override the ECP. To support this claim, the paper presents an experimental study. The results corroborate the existence of systematic QUD effects on the ECP, and support the view that the ECP is derived from a confluence of various pragmatic and lexical biases.

Keywords: Epistemic Containment Principle (ECP), epistemic modals, Question Under Discussion (QUD), quantifiers, scopal ambiguity, experimental semantics.

1. Introduction

The Epistemic Containment Principle (henceforth ECP) is a widely known descriptive and theoretical claim according to which epistemic modals must take wider scope than strong quantifiers such as every or most (von Fintel and Iatridou, 2003). The ECP can capture, for instance, why a sentence like (1) sounds infelicitous. As the scopal ordering that would have yielded a felicitous meaning (1b) is in effect ruled out by the ECP, the only possible interpretation that is left is (1a), which results in an unlikely meaning ((1a) is tenable only if multiple people can collectively constitute ‘the murderer’).

(1) #Every student might be the murderer. (von Fintel and Iatridou, 2003)
   a. MIGHT ≻ EVERY: It is possible that every student is the murderer.
   b. #EVERY ≻ MIGHT: For every student x, it is possible that she is the murderer.

Although fairly robust in its realization, a few systemic classes of counterexamples to the ECP have been noted. They involve the distinction between subjective vs. objective epistemic modals, and differences in quantifier types.

(2) a. Objective vs. subjective (doxastic)
   Objectively speaking, every student might be the murderer. (Tancredi, 2007)

   b. Quantifier type
   Each student might be the murderer. (Tancredi, 2007)

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For instance, epistemic modals that quantify over objective knowledge states have been shown to allow quantifiers to scope over them, as indicated by the felicity of (2a). Based on this, Tancredi (2007) concluded that only subjective epistemic modals (which he calls ‘doxastic’ and assumes to be the default interpretations) that quantify over the speaker’s subjective belief states observe the ECP (cf. Lyons, 1977; Anand and Hacquard, 2008). In addition, quantifiers such as each have been shown to be able to violate the ECP, as indicated by the felicity of (2b).

These counterexamples raise questions about the nature and the status of the ECP. First, is the ECP a hard-wired structural constraint, as von Fintel and Iatridou (2003) had initially conceptualized, or is the intuition behind it better characterized as a gradient tendency, as Anand and Hacquard (2008) suggest? Secondly, if the ECP can be reduced to a kind of gradient preference, how robust is this preference, and what factors come into play in shaping this preference? Answering these questions will go some way towards explaining why exactly the ECP arises in the first place, and how it connects with the more general tendency for epistemic modals to scope wide.

The aim of this paper is to engage with these questions by pursuing two specific empirically tractable goals. The first is to measure the robustness of the intuition behind the ECP via quantitative methods. The second is to introduce a new contextual factor that also seems to systematically influence the realization of the ECP, namely, Questions Under Discussion (henceforth QUDs; Roberts, 1996). The paper argues that listeners tend to prefer scopal orderings that provide relevant answers to the given QUDs, and that this preference can override the ECP.

To achieve these goals, an experimental study is presented. The results of the study corroborate the significant effects of QUDs on the ECP, while also demonstrating that violations of the ECP can occur even for subjective modals and for the quantifier every. Based on these data, the paper propounds the view that the ECP arises from a combination of various pragmatic and lexical biases. The resulting account is shown to have broader implications for thinking about the scopal preferences of epistemic modals, as well as how context comes into play in shaping these preferences.

2. QUD effects on the ECP: Probing the intuition

Suppose that the same sentence from (1), repeated in (3b), was uttered in answer to an explicit question in (3a).

\[(3) \quad a. \quad \text{Which of the four students is the murderer?} \]
\[b. \quad \text{Every student might be the murderer.} \]

The sentence sounds distinctly better in (3) than in (1), although the quantifier every and the subjective modal interpretation have remained constant. This relative felicity seems to stem from the fact that the ECP-violating EVERY ≻ MIGHT interpretation provides a directly relevant answer to the explicit QUD in (3).

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2 As a structural constraint, the ECP is characterized by von Fintel and Iatridou (2003) as follows: At LF, a quantifier cannot bind its trace across an epistemic modal.
Figure 1: Ron is at a zoo. Ron knows for certain that the cage is currently housing exactly two tiger cubs and exactly one panther cub. Ron also knows for certain that the animals look as in (a). Ron peers through the cage, which looks as in (b).

QUDs (Roberts, 1996; cf. Ginzburg, 1996) signal what is at-issue, and provide a systematic way of capturing the information structure in the discourse. They have been argued to be at the heart of a variety of linguistic phenomena such as focus and focus-sensitive expressions (Beaver and Clark, 2008), projection behavior (Simons et al., 2010), and the meaning contribution of diverse discourse particles. This work indicates that the at-issueness status as prescribed by QUDs has far reaching repercussions for a wide range of linguistic expressions and the way they are interpreted. Given this, it seems reasonable to expect that QUDs would also impact scopal disambiguation processes. In particular, scopal orderings that provide relevant answers to the QUDs are likely to be preferred over ones that don’t (cf. Gualmini et al., 2008).

By linking this broader QUD intuition with the ECP phenomenon, we may entertain the following hypothesis: Suppose that the ECP can be recast as a kind of default but defeasible scopal disambiguation strategy or preference which is derived from more primitive lexical and pragmatic biases. Since it operates as a mere preference rather than a structural constraint, we expect it to be overridden by independent scopal preferences arising from QUDs when the two are in conflict, if the preferences stemming from QUDs are stronger. The QUD-based scopal preferences are likely to be stronger when the QUDs are explicitly spelled out.

Let us henceforth call this the QUD hypothesis and probe our intuitions about it with the aid of a paradigm that doesn’t involve felicity judgments. (The same paradigm is implemented in a larger scale in the experimental study presented in sec. 4.) For instance, consider the context outlined in Fig. 1. In this context, suppose that Ron utters the modal statement given in (4):

(4) “Every bush might have a tiger.”
   a. MIGHT $\triangleright$ EVERY: FALSE
      It is possible that every bush has a tiger.
   b. EVERY $\triangleright$ MIGHT: TRUE
      For every bush x, it is possible that x has a tiger.

Given the context in Fig. 1, the presence vs. absence of the ECP can be probed by examining whether Ron’s answer is interpreted as true or false. Given what Ron knows and believes, Ron’s statement in (4) is interpreted as true only under the ECP violating scopal ordering (4b), but...
false under the ECP observing one (4a). This holds regardless of which QUD (4) is addressing. Since Ron knows that there are only 2 tigers in total, it is not possible that all three bushes have tigers (4a). In other words, in none of Ron’s epistemically and doxastically accessible worlds is it the case that every bush has a tiger. In contrast, since Ron also knows that tigers and panthers have identical looking tails, for each bush x, it is equally possible that x has a tiger (4b). In other words, Ron’s epistemically and doxastically accessible worlds include worlds in which any given bush x has a tiger. In sum, if Ron’s statement in (4) is evaluated as true, it indicates that the ECP was violated, and if it is evaluated as false, it indicates that the ECP was observed.

Building on this basic premise, let us now introduce explicit QUDs. Suppose that Ron produced his model statement in (4) as an answer to one of the two explicit questions in (5) and (6). The question was raised by his friend Luna who arrived late at the scene (and is thus more ignorant than Ron about the number and the shape of tigers involved).

(5) **HOW-QUD:**

“How many of the three bushes have a tiger?”

(6) **WHICH-QUD:**

“Which of the three bushes has a tiger?”

The emerging intuition is that our true vs. false judgment of Ron’s statement in (4), which maps onto the violation vs. observation of the ECP, respectively, depends crucially on the type of explicit QUD that (4) is addressing. In answer to the question in (5), henceforth the **HOW-QUD**, Ron’s statement is more likely to be evaluated as false, suggesting that the QUD is nudging us towards the ECP-observing scopal interpretation. In answer to the question in (6) however, henceforth the **WHICH-QUD**, Ron’s statement is more likely to be evaluated as true, suggesting that the QUD is nudging us towards the ECP-violating scopal interpretation. Intuitively, the reason for this seems to be as follows: the ECP-violating interpretation (4b) provides a relevant answer to the **WHICH-QUD** but not to the **HOW-QUD**, whereas the ECP-observing interpretation (4a) provides a relevant answer to the **HOW-QUD** but likely not to the **WHICH-QUD** (cf. see sec. 3). In sum, ECP-violating interpretations seem to become more accessible when they can provide relevant answers to the explicit QUDs.

If the intuition outlined so far is on the right track, it suggests that the QUD bias does indeed override the ECP, which in turn suggests that the ECP is at best a defeasible bias rather than a categorical constraint. The hypothesized QUD effect also seems to crosscut other factors that have been known to influence the ECP. The sentence in (4) includes the quantifier *every* but still seems to allow for the ECP-violation depending on the QUD. Likewise, given the context of ignorance (Fig. 1b) and in the absence of explicit adverbials like ‘objectively speaking’,

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3 One may wonder if providing true/false judgments to subjective/doxastic modal statements is an unintuitive task. However, people do seem to be able to make true value judgments about subjective epistemic modal statements, although the body of knowledge/beliefs against which such a modal statement is evaluated may shift (von Fintel and Gillies, 2011). Since we, as readers, are led to share identical beliefs as those of Ron’s (w.r.t. the tigers and the bushes) by virtue of Fig. 1, the proposed equivalence between true vs. false judgments and ECP violation vs. observation would hold regardless of this potential shift.

4 This equivalence holds under the assumption that Ron’s knowledge and belief states described in Fig. 1 are fully taken into account when generating the relevant modal base for the statement. See sec. 4.3.2 for more discussion about the validity of this assumption.
the sentence in (4) most likely elicits the default subjective/doxastic modal interpretation but nevertheless seems to allow for the ECP-violation depending on the QUD.

The experimental study to come (sec. 4) aims to provide quantitative support for the QUD hypothesis described so far by implementing a paradigm like Fig. 1 and (4)–(6). Before presenting the experiment however, let us first get a better handle on why the proposed relevance relations hold between the WHICH-QUD and the ECP-violating interpretation (4b) on the one hand, and the HOW-QUD and the ECP-observing interpretation (4a) on the other.

3. Defining relevance for modalized statements

The QUD hypothesis in sec. 2 was formulated on the basis of the assumption that EVERY ≻ MIGHT propositions like (4b) provide relevant answers to certain types of questions like (6), while MIGHT ≻ EVERY propositions like (4a) provide relevant answers to other types of questions like (5). These judgments seem to be corroborated by native speaker intuitions, but we may want to formulate them in a more precise manner as they will figure as core background assumptions in the experiment.

There are several ways of gauging whether a given proposition counts as a relevant answer to a question. Since it is not the main goal of the paper to argue for a specific theory of relevance, we will consider three possible ways of defining ‘relevance’ and establish that the hypothesized relevance relations are predicted by all of them, although to different degrees.

A proposition is standardly analyzed as being a relevant answer to a question Q if it identifies or rules out a member of the question denotation Q (cf. Groenendijk and Stokhof, 1984; Roberts, 1996; Dayal, 2016). However, hedged/modal answers (e.g., might p, I think that p, etc.) can also count as relevant answers to simple/non-modal questions (e.g., whether p?), although modal propositions do not themselves identify/rule out any member of such Qs. In these cases, what matters seems to be the prejacents: if the prejacents of the modal statements identify/rule out a member of Q, they count as relevant answers. We will therefore posit the following core premise across all three accounts: In the case of a modal statement, the proposition with which we evaluate its relevance to a given question is its prejacent p (see Beaver and Clark (2008) and Kaufmann (2016) for similar views).

Following this assumption, let us zoom in on the prejacents of the ECP-observing (4a) and ECP-violating (4b) when evaluating their relevance to different QUDs. They are presented again in (7) and (8) in a more detailed form; B stands for the modal base and the underlined parts pick out the prejacents. The prejacent of (7) is straightforward; it is the proposition: every bush has a tiger. Determining the prejacent of (8) requires more flexibility: when a modal takes a narrow scope as in (8), the propositional argument of the modal contains a free variable x, resulting in: x has a tiger. In this case, we define its prejacent as follows: any member of the set of propositions that results when the free variable x of the propositional argument is assigned to a member of the restrictor of every. To give a unified account, we also posit that the prejacent of (7) is the sole member of an analogous prejacent set in (7b), which is a singleton set.
(7)  
\[ \text{might} \succ every \]
\[ a. \text{MIGHT}(B)(\text{every bush}(\lambda x(\text{a tiger}(\lambda y(x \text{ has } y)))))) \]
\[ b. \text{prejacent set: } \{ [\text{every bush has a tiger }]^g \} \]

(8)  
\[ \text{every} \succ \text{might} \]
\[ a. \text{every bush}(\lambda x(\text{MIGHT}(B)(\text{a tiger}(\lambda y(x \text{ has } y)))))) \]
\[ b. \text{prejacent set: } \{ [\text{bush}(x) \wedge \text{has a tiger}(x)]^g[x\mapsto b] : b \in D_x \} \]

With these assumptions in place, one way of defining relevance is as in (9b).\(^5\)

(9)  
\[ a. \text{Q: a set of propositions that are possible answers to } Q \quad \text{(cf. Hamblin 1971)} \]
\[ b. \text{Relevance (ver. 1): A proposition } p \text{ is a relevant answer to a question } Q \text{ iff: } p \in Q \]

Assuming that a given question \( Q \) denotes a Hamblin set \( Q \), i.e., a set of contextually constrained possible answers to \( Q \) as in (9a), the HOW-QUD in (5): \textit{How many of the 3 bushes have a tiger?} would have the denotation in (10a), and the WHICH-QUD in (6): \textit{Which of the 3 bushes has a tiger?} would have the denotation in (10a), where \( [\text{bush}] = \{ b_1, b_2, b_3 \} \).

(10)  
\[ a. \quad [\text{HOW-QUD}] = \{ ([\text{no bush has a tiger}]), [\text{one bush has a tiger}], [\text{two bushes have a tiger}], [\text{three bushes have a tiger}] \} \]
\[ b. \quad [\text{WHICH-QUD}] = \{ [\text{has a tiger}](b_1), [\text{has a tiger}](b_2), [\text{has a tiger}](b_3), \]
\[ [\text{has a tiger}](b_1 + b_2), [\text{has a tiger}](b_2 + b_3), [\text{has a tiger}](b_1 + b_3), \]
\[ [\text{has a tiger}](b_1 + b_2 + b_3) \} \]

From (9b), it follows that the ECP-observing (7) is a relevant answer to both the HOW-QUD in (5) and the WHICH-QUD in (6): The prejacent \( p \) of (7) is a member of the denotations of both QUDs as the proposition \( [\text{every bush has a tiger}] \) is contextually equivalent to \( [\text{three bushes have a tiger}] \) and \( [\text{has a tiger}](b_1 + b_2 + b_3) \). In contrast, the ECP-violating (8) is only a relevant answer to the WHICH-QUD but not a relevant answer to the HOW-QUD. This is because all of its possible prejacents from (8b), e.g., \( [\text{has a tiger}](b_2) \), are members of \( [\text{WHICH-QUD}] \), whereas none of them are members of \( [\text{HOW-QUD}] \).

We remain agnostic about whether the denotation of the HOW-QUD should include \( [\text{no bush has a tiger}] \); the same prediction comes out irrespective of this choice. We also take the conservative approach of assuming that the partitive wh-phrase ‘Which of \( x \)’ is associated with the domain of not just atomic individuals but also plural ones; if only atomic individuals are allowed, as is standardly assumed to be the case for ‘Which \( x \)’ (Dayal, 2016), then the denotation of WHICH-QUD would be \( \{ [\text{has a tiger}](b_1), [\text{has a tiger}](b_2), [\text{has a tiger}](b_3) \} \) and the current account would predict an even stronger asymmetry: that the ECP-violating (8) is only relevant to the WHICH-QUD and the ECP-observing (7) is only relevant to the HOW-QUD.

Relevance can also be defined in terms of partitions introduced by a given question (Groenendijk and Stokhof, 1984). A partition of \( Q \) can be derived from a Hamblin set \( Q \) (Fox, 2017),

\(^5\) Note that (9b) does not impose that the relevant answer be a true answer. The notion of ‘relevance’ that we are after is only concerned with whether the proposition is directly germane to a given question.
as shown in (11a). Unlike propositions in Hamblin sets that can pick out overlapping worlds, partitions cut up the worlds into equivalence classes. Each cell in the partition(Q) correspond to an exhaustive answer. Oftentimes, answers to questions are non-exhaustive in form but understood exhaustively. Given this, we may posit an exhaustivity operator as in (11b) which (roughly) strengthens p to only p (P+ stands for focus alternatives), and define relevance as in (11c). Simply put, p is a relevant answer to Q if upon strengthening to EXH(p), it identifies a cell in partition(Q).

\[(11) \begin{align*}
\text{a.} & \quad \text{Partition}(Q): \text{a set of equivalence classes under the relation:} \\
& \quad w \sim w' \text{ iff } \forall p \in Q[p(w) = p(w')] \\
& \quad \text{(Groenendijk and Stokhof, 1984; Fox, 2017)} \\
\text{b.} & \quad \lbrack \text{EXH} \phi \rbrack = \lbrack \phi \rbrack \land (\land_{p \in \lbrack \phi \rbrack_{P+}} \neg p) \\
& \quad \text{(Klinedinst and Rothschild, 2011: 11)} \\
\text{c.} & \quad \text{Relevance (ver. 2): } p \text{ is a relevant answer to Q iff: EXH}(p) \in \text{Partition}(Q)
\end{align*}\]

From (11c), it follows that the ECP-observing (7) is a relevant answer to both the HOW-QUD in (5) and the WHICH-QUD in (6), whereas the ECP-violating (8) is only a relevant answer to the WHICH-QUD, but not the HOW-QUD. To see more concretely why this holds, let us imagine the possible worlds in Fig. 2 as constrained by the context. Given these possible worlds, the partitions introduced by the \lbrack \text{HOW-QUD} \rbrack and the \lbrack \text{WHICH-QUD} \rbrack are as in (12a) and (12b).

\[(12) \begin{align*}
\text{a.} & \quad \text{Partition}(\lbrack \text{HOW-QUD} \rbrack) = \{\{w_1\}, \{w_2, w_3, w_4\}, \{w_5, w_6, w_7\}, \{w_8\}\} \\
\text{b.} & \quad \text{Partition}(\lbrack \text{WHICH-QUD} \rbrack) = \{\{w_1\}, \{w_2, w_3\}, \{w_4\}, \{w_5\}, \{w_6\}, \{w_7\}, \{w_8\}\}
\end{align*}\]

Given (12a) and (12b), the exhaustified prejacent of the ECP-observing (7), presented in (13a), is a member of both Partition(\lbrack \text{HOW-QUD} \rbrack) and Partition(\lbrack \text{WHICH-QUD} \rbrack). In contrast, any exhaustified prejacent of the ECP-violating (8), one of which is exemplified in (13b), is a member of Partition(\lbrack \text{WHICH-QUD} \rbrack) but crucially not a member of Partition(\lbrack \text{HOW-QUD} \rbrack). This combined with (11c) predicts the same kind of asymmetry captured by the previous account.

\[(13) \begin{align*}
\text{a.} & \quad \text{EXH}(\lbrack \text{every bush has a tiger} \rbrack) = \{w_8\} \quad \text{(cf. } \lbrack \text{every bush has a tiger} \rbrack = \{w_8\}\} \\
\text{b.} & \quad \text{EXH}(\lbrack \text{has a tiger} \rbrack(\{b_1\})) = \{w_2\} \quad \text{(cf. } \lbrack \text{has a tiger} \rbrack(\{b_1\}) = \{w_2, w_5, w_7, w_8\}\}
\end{align*}\]

The two accounts outlined so far already generate the asymmetric relevance relations we need. However, the asymmetry predicted by both seems to be weaker than expected, as the ECP-observing (7) is predicted to provide relevant answers to both QUDs. The prejacent of (7) actually seem like an odd answer to the WHICH-QUD (6), but this intuition is not captured by the accounts (unless, as noted above, we posit a domain of atomic individuals for (6)). Intuitively, (7) sounds odd in response to (6), because the questioner of (6) seems to assume...
some kind of non-maximality: she thinks that a unique bush or at most two bushes have tigers. The prejacent of (7) goes against this assumption, while the prejacent of (8) satisfies it. Such an intuition can be incorporated into the third account in (14b), which posits Partition\((\mathcal{Q}, cs_\mathcal{Q})\). This partition retains only the cells in Partition\(\mathcal{Q}\) that are consistent with the questioner’s assumptions, as in (14a). This account predicts a stronger asymmetry, where the ECP-observing (7) only provides a relevant answer to the HOW-QUD (this is because unlike Partition\([\text{WHICH-QUD}]\)), Partition\([\text{WHICH-QUD}], cs_\mathcal{Q}\) no longer contains \(\{w_8\}\), and the ECP-violating (8) only provides a relevant answer to the WHICH-QUD.

\begin{equation}
\text{(14)} \quad \text{a. Partition}(\mathcal{Q}, cs_\mathcal{Q}): \{ P \cap cs_\mathcal{Q} : P \in \text{Partition}(\mathcal{Q}) \} \setminus \{\emptyset\} \quad \text{where } cs_\mathcal{Q} \text{ stands for the context set (set of possible worlds) consistent with the questioner’s assumptions}
\end{equation}

\begin{equation}
\text{b. Relevance (ver. 3): } p \text{ is a relevant answer to } Q \text{ iff: } \text{ExH}(p) \in \text{Partition}(\mathcal{Q}, cs_\mathcal{Q})
\end{equation}

The discussion in this section suggests that the relevance intuitions we began with are warranted and can be spelled out in different ways. Having established the needed relevance relations, the next section presents the main experimental study.

4. Experiment

The experiment presented in this section tests the QUD hypothesis outlined in sec. 2. The paradigm it adopts is largely identical to the one already presented in Fig. 1 and (5)–(4) in sec. 2. In the experiment, participants familiarized themselves with a series of situations by reading the prompts and the associated visual stimuli. Against varying contextual backdrops, the main speakers in the target trials uttered sentences of the form: every X might have a Y. The sentence was either uttered out of the blue (no clear surrounding dialogue) or in response to an explicit QUD. The situation and the visual stimuli were set up in such a way that the sentence uttered by the main speaker would be interpreted as true only under the ECP-violating scopal ordering (\textsc{every} \textgreater \textsc{might}) but false under the ECP-observing scopal ordering (\textsc{might} \textgreater \textsc{every}). The main task of the participants was to judge whether the sentences spoken by the main speakers were true or false. In sum, as adumbrated in sec. 2, the core assumption that underlies this experimental design is that we can track participants’ ECP violating interpretations in an intuitive way by examining their True/False responses.

4.1. Methods

4.1.1. Participants

600 native speakers of American English were recruited as participants from Amazon Mechanical Turk. They were paid $0.50 to participate.
4.1.2. Materials

The visual stimuli and the prompts for each trial had different configurations depending on whether it was a target condition or a baseline condition. There were three target conditions and three baseline conditions.

The three target conditions, **HOW**, **WHICH**, and **NOQUD**, were associated with an identical range of visual stimuli and context prompts, but differed in the presence vs. absence of an explicit QUD and the type of QUD. The visual stimuli shared the basic paradigm exemplified in Fig. 1. All stimuli established situations in which the main speakers accounted for objects (tiger cubs, cherry toppings, butterfly cocoons, etc.) distributed across containers (bushes, icecream sundaes, beakers, etc.). For ease of reference, an example of the visual stimuli and a condensed version of the prompt that we already saw in Fig. 1 are reproduced in Fig. 3.

To ensure that a full correspondence is established between ECP violations and True responses on the one hand, and ECP observations and False responses on the other, the speakers’ epistemic states were made clear via the visual stimuli and the prompt. In each situation, the speakers were shown to definitively know the cardinality of the items (1 or 2 items distributed across 3 containers) as well as the fact that there is visual ambiguity in identifying them. This information served to constrain the epistemic/doxastic modal bases (Kratzer, 1981) in intended ways, so that as long as the participants incorporated them in their interpretations, the associated modal statements would be evaluated as true under the ECP violating ordering (EVERY ≻ MIGHT) but false under the ECP observing one (MIGHT ≻ EVERY).

Along with these prompts and visual stimuli, the three target conditions introduced the QUD manipulations summarized in (15). The **WHICH** condition introduced **WHICH-QU**Ds in the format of *Which of X has a Y?*, such as: *Which of the three bushes has a tiger?* The **HOW** condition introduced **HOW-QU**Ds in the format of *How many of X have a Y?*, such as: *How many of the three bushes have a tiger?*, and the **NOQUD** condition did not have any explicit QUD effects on epistemic containment principle.
The cage looks as in (a). Ron peers through the cage, which looks as in (b).

**Figure 4:** Sample visual stimuli for the *TRUE* baseline condition

Context prompt: Ron is at a zoo. Ron knows that the cage is currently housing exactly three tiger cubs. Ron also knows that the tigers look as in (a). Ron peers through the cage, which looks as in (b).

QUDs. If an explicit QUD was present, it immediately preceded the target modal sentence.

(15) Three target conditions
a. WHICH condition
   A friend arrives and asks the main speaker: “*Which of X has a Y?*”
   The main speaker replies: “*Every X might have a Y.*”

b. HOW condition
   A friend arrives and asks the main speaker: “*How many of X have a Y?*”
   The main speaker replies: “*Every X might have a Y.*”

c. NOQUD condition:
   (no explicit QUD; no mention of another friend)
   The main speaker says: “*Every X might have a Y.*”

In addition to these three target conditions, the experiment also included three baseline conditions: TRUE, FALSE, and NO-M. As we will see later, these provided analytically useful points of comparison and ensured that the experimental design worked in the intended way. First, in the TRUE condition, visual stimuli and context prompts were designed to generate modal bases that would render the associated modal statements True under both the ECP-observing scopal ordering and the ECP-violating scopal ordering. The modal statements that were presented were identical to those from the target conditions: *Every X might have a Y.* The statements were uttered by the speaker in the absence of any explicit QUD. A sample prompt and visual stimuli using the same items from Fig. 3 are given in Fig. 4. In this context, Ron’s utterance: *Every bush might have a tiger:* would be evaluated as True regardless of the choice in scopal ordering.

Second, in the FALSE condition, visual stimuli and context prompts were designed to generate modal bases that would render the associated modal statements False under both the ECP-observing scopal ordering and the ECP-violating scopal ordering. Again, the modal statements that were presented were identical to those from the target conditions: *Every X might have a Y,* and the statements were uttered by the speaker in the absence of any explicit QUD. A sample prompt and visual stimuli are given in Fig. 5. In this context, Ron’s utterance: *Every bush might have a tiger:* would be evaluated as False regardless of the choice in scopal ordering.
Context prompt: Ron is at a zoo. Ron knows that the cage is currently housing exactly two tiger cubs and exactly one fennec fox cub. Ron also knows that the animals look as in (a). Ron peers through the cage, which looks as in (b).

In particular, the last bush in the cage in Fig. 5b clearly has a fox tail and is incompatible with hiding a tiger; it thus renders the associated modal statement False even under the ECP-violating scopal ordering.

Finally, in the NO-M condition, a range of visual stimuli and prompts that were identical to the ones in target conditions (e.g., Fig. 3) was presented. However, the sentences uttered by the main speakers were non-modal statements in the form of: Every X has a Y, such as: Every bush has a tiger. Given the context (in particular, the cardinality information such as Fig. 3a), these non-modal statements (which are equivalent to the prejacents of the modals in the ECP-observing MIGHT ≻ EVERY interpretations) would be evaluated as False.

4.1.3. Procedure

The experiment had five trials. One of the trials was a filler trial, and the remaining four were target and baseline trials. Each participant saw all three target conditions (WHICH, HOW, NO-QUD) and one of the three baseline conditions (TRUE, FALSE, NO-M). Each of the five trials was associated with five distinct scenarios and visual stimuli, such that no participant saw the same type of scenario/item across conditions/trials.

The filler trials involved cases where the questioner asks identification questions such as Which pot has a dessert lotus shoot?, and the main speaker responds with unambiguously true or false answers (given the visual information) involving neither modals nor quantifiers; e.g., The pot in the middle has a dessert lotus shoot. Responses to fillers were later checked to confirm that participants paid attention to the experimental tasks.

In each trial, participants answered the questions summarized in (16) after familiarizing themselves with the set-up and the target utterance. The main task was the True/False judgments in (16a), but there was also a gradient rating task (16b) as well as an optional free response question (16c). The experiment lasted an average of 8 minutes.
(16) Questions in each trial
   a. Q1: Is what [the speaker] said True or False? (forced choice)
   b. Q2: How confident are you about your response to Q1? (ratings from 0–100)
   c. (Optional) Any comments?

4.2. Predictions

Given the relevance relation argued for in sec. 3, the following predictions emerge for the target conditions: (i) The WHICH condition will elicit significantly more True responses, i.e., more ECP violations, than the HOW condition. (ii) The NOQUD condition will pattern in between the WHICH condition and the HOW condition, as participants may reconstruct a range of different QUDs. The predictions for the baseline conditions are straightforward: the TRUE condition is expected to elicit predominantly True responses; the FALSE and the NO-M condition are expected to elicit predominantly False responses.

4.3. Results

Participants’ True/False responses (in %) depending on the 6 conditions are plotted in Fig. 6, along with a summary of the conditions (Table 1). The vertical axis represents the 6 conditions, and the horizontal axis represents percent values. True responses are coded in green, and False responses in red. Error bars represent 95% confidence intervals.

The data were analyzed using a mixed effects logistic regression model with by-participant random intercepts, predicting True/False responses (dependent variable) from the 6 conditions (independent variable). By-situation random intercepts were initially posited as well, but were later dropped as they did not capture any significant variance. The model was fitted using the lmerTest package (Kuznetsova et al., 2016) in R (R Core Team, 2015). A summary of the fixed effects can be found in the link in the appendix.

4.3.1. Target conditions: QUD effects on the ECP

As predicted, the WHICH condition elicited significantly more True responses, which translates into more ECP violations, than the HOW condition ($\beta = -0.41$, $SE = 0.13$, $z = -3.11$, $p < 0.01$). Fig. 6 captures this: the green bar (True responses) in the WHICH condition is distinctly higher than the one in the HOW condition. In comparison, there was no significant difference between the NOQUD condition and the HOW condition, and between the NOQUD condition and the WHICH condition. While these differences were not significant, Fig. 6 demonstrates that the bars of the NOQUD condition fall somewhere in-between those of the WHICH condition and the HOW condition, as expected.
In sum, the results support the main hypothesis that QUDs significantly affect the ECP: Scopal orderings that provide relevant answers to the QUDs are favored, and this tendency can override the ECP preference (as in the case of the WHICH condition).

More globally, all three target conditions including the HOW condition elicited non-negligible proportion of True responses, indicating ECP-violations. Fig. 6 demonstrates that the proportions of True responses for all three target conditions are above 50%. This is unexpected if the ECP operated as a categorical constraint or even as a strong bias. If this was the case, then we would expect the ECP to be near-categorically observed as long as certain preconditions are satisfied (e.g., in the HOW condition where the QUD bias aligns with the ECP bias and the statements involve subjective interpretations and the quantifier every), predicting near-categorical False responses for such conditions. To probe the implications of the surprisingly robust number of True responses, let us conduct a more detailed examination of the baseline conditions and participants’ free responses.

### 4.3.2. No-M vs. False condition: unrealistic modal bases

The availability of True responses across all three target conditions suggests that the ECP may be violated more easily than previously assumed. In order for us to arrive at this conclusion however, we first need to rule out alternative explanations. In particular, is it possible that the core experimental assumption, namely, that True responses are fully equivalent to violations of the ECP, was not always met? This assumption was grounded on the fact that the experimental trials always provided explicit information about the speakers’ epistemic states. As long as this information was included in creating the modal bases, the ECP-observing orderings could not possibly yield True evaluations; only ECP-violating orderings would allow them.
Nevertheless, participants might occasionally have granted more leeway in constructing the modal bases than is strictly allowed from the visual information. If this is the case, then some of the True responses in the target conditions may correspond not to genuine ECP violations, but rather to cases where participants posited unrealistic modal bases. For example, given a scenario like Fig. 3, certain participants might have included in the modal base worlds in which the ECP-observing prejacent ‘every bush has a tiger’ is true, despite the fact that the visual information and the speaker’s epistemic/doxastic state clearly ruled this out.\(^7\)

Is there a way of probing whether such exceptional interpretations occurred, and if so, how often? Comparing the two baseline conditions: FALSE and NO-M might provide a window into this issue. The FALSE condition, as expected, elicited primarily false responses (more than 70%). However, it also allowed for significantly more true responses than the NO-M condition ($\beta = -1.00, SE = 0.35, z = 2.83, p < 0.01$). This is not expected if we assume that participants always fully included the contextual/visual information when construing the modal bases of the speakers: in the FALSE condition such as Fig. 5, the information in Fig. 5b rules out the ECP-violating interpretation being true, while the information in Fig. 5a (shared by the target conditions) rules out the ECP-observing interpretation being true.\(^8\) Nevertheless, the FALSE condition occasionally allowed True responses, suggesting that participants may not always have taken this information fully into account. Based on this, we may conclude that analogous cases of laxer construal of modal bases existed, albeit to a small degree, in the three target conditions as well.

4.3.3. Target vs. False condition: no ECP?

However, the significant number of True responses in the three target conditions cannot all be reduced to exceptional cases where participants posited laxer, unrealistic modal bases. If this were the case, we would at least expect these conditions to pattern with the FALSE condition. In other words, the rate at which such laxer construals occurred (and manifested as True responses despite observing the ECP) would be at best equivalent to the FALSE condition, and most likely lower.\(^9\) As it turns out however, not only the WHICH condition, but also the NOQUD and the HOW condition elicited significantly more True responses than the FALSE condition (e.g., comparing the HOW condition with the FALSE condition: $\beta = 1.17, SE = 0.22, z = 5.23, p < 0.001$). This suggests that significant parts of the True responses in all three target conditions are indeed reflections of genuine ECP violations.

This state of affairs is corroborated further by participants’ free responses. A few comments that unambiguously confirm the availability of the ECP violating scopal interpretations (every

\(^7\) Since the target modal sentences did not have any explicit adverbials like ‘based solely on’ (cf. Portner, 2007), it seems highly unlikely that this happened frequently.

\(^8\) The partial visual information given in Fig. 5b introduces weaker, more defeasible information than the information about cardinality given in Fig. 5a. So it is also possible that many of the True responses in the FALSE condition reflect participants’ uncertainty about the information given in Fig. 5b, rather than indicate that participants reconstructed unrealistic modal bases.

\(^9\) This is because as mentioned in footnote 8, the information about cardinality such as Fig. 3a is a much stronger piece of information and is thus harder to ignore than the partial visual information such as Fig. 5b.
might) are presented in (17). All 3 target conditions elicited some amount of free responses in the vein of (17), confirming the general availability of ECP violations across conditions.

(17) a. “I think she means each statue has the potential to have a blue sapphire not that all of them will.”
b. “It is tricky to know if George means there are 3/3 moss butterflies or (if he means) each beaker (could) possibly contain one.”
c. “this is true because you don’t know which one it is. Obviously one of them doesn’t have a maraschino cherry but it’s possible that the one you choose will.”
d. “Every bush MIGHT have one until you find the two and then the last bush would not have one.”

In sum, the results for the three target conditions suggest that the ECP violating interpretations are more available than previously assumed, and confirm the main hypothesis that the QUD-based scopal biases boost this availability further.

4.3.4. Target vs. True condition: evidence for the ECP

Faced with this rather pervasive availability of ECP-violating scopal orderings, one may begin to wonder if our intuitions about the ECP were perhaps illusory. However, the results of the experiment also suggest that some kind of bias that works towards creating the intuition behind the ECP does exist. If the ECP-violating scopal orderings were as available as the ECP-observing ones, then we would expect the three target conditions to pattern more like the True condition (modulo the effects of QUDs), as participants would have had full access to the scopal ordering that renders the statement true. Since people tend to prefer interpretations that render the statement true when there is ambiguity (Gualmini et al., 2008; cf. Meyer and Sauerland, 2009), we would expect participants to predominantly choose the ECP-violating ordering if there weren’t any bias against it. However, all three conditions also elicited significantly fewer True responses than the True condition (e.g., comparing the WHICH condition with the True condition: $\beta = -1.92, SE = 0.21, z = -9.07, p < 0.001$); and the proportion of True responses for the three target conditions fell somewhere in-between the FALSE condition and the True condition, differing significantly from either of the baselines. This suggests that there exists some kind of gradient preference towards the ECP-observing scopal ordering that is activated to a different degree depending on various factors (one of which, as we saw, is the QUD).

4.3.5. Variability of the intuition behind the ECP

To some extent, scopal preferences varied depending on the language user. Comments like (17) indicate that certain participants had no trouble resorting to ECP-violating scopal interpretations. In comparison, comments like (18) indicate that other participants were more strongly 10The full list of free responses is provided in the .csv file that can be accessed via the link in the appendix.
biased against them.  

(18) a. “Interesting. This depends on how you interpret ‘every pot might...’ I would lean towards (this meaning) that all 3 pots would have a desert lotus shoot and not just that each pot might potentially have a desert lotus root.”

b. “The more I think about it I guess every bush MIGHT have a tiger cub but it just is not the correct way to say this.”

Participants’ certainty ratings (i.e., their answers to Q2) also provide indirect evidence for the existence of this variability. If participants shared essentially the same kind of scopal preference, and if the contrast between True vs. False responses (and also between the comments in (17) and (18)) are just manifestations of their stochastic decisions when faced with ambiguity, we would expect their certainty ratings for the three target conditions to be significantly lower than those for the three baseline conditions. However, no significant difference in certainty ratings emerged across the 6 conditions when a mixed effects regression model was fitted (with certainty ratings as the dependent variable and conditions as the independent variable; and with by-participant random intercepts). This suggests that proponents of (17) vs. (18) were certain about their respective intuitions, which varied significantly from each other.

5. Discussion

The current experimental study provides evidence for the view that the ECP is at best a defeasible/gradient bias whose manifestation is subject to a variety of factors (cf. Anand and Hacquard, 2008), one of which is the QUD.

Does this ‘ECP bias’ have an independent presence, or can it be reduced to a combination of more primitive lexical and pragmatic biases? The paper suggests that the latter option is more likely, and that the ECP bias primarily reflects lexical biases associated with various quantifiers and/or modals. It is widely known that epistemic modals like might tend to take wide scopes. It is also known that different types of quantifiers are susceptible to the ECP to different degrees: each seems to more easily allow ECP violations than every (Tancredi, 2007); and every in turn seems to more easily allow ECP violations than all. This state of affairs can be straightforwardly captured if one posits that quantifiers come pre-equipped with different scopal preferences. More specifically, they prefer or allow wide scopes in the following order: each > every > all. Since might prefers to take wide scope and every doesn’t, something like the ECP bias is predicted to emerge. Such a view is indirectly supported by

11 In addition to user-dependent variation, other factors such as intonation also seem to influence the activation of ECP, as indicated by comments such as “It depends on if she emphasizes the word ‘every’ or ‘might’.”

12 Since each participant only did a single trial for each condition, we cannot know if a given participant would have provided consistent responses across multiple trials of the same condition. If this turned out to be the case, and if distinct groups of answer patterns were to emerge, we would have more direct evidence.

13 This intuition was confirmed via a separate experimental study that mainly tested the effects of evidential adverbials on the ECP. Since the study is not directly relevant to the main argument of the current paper, it is not presented here. However, the results as well as the experiment itself can be found in the link in the Appendix.

14 The present account would predict that ECP-violations would be even less available for the quantifier all (compared to every), although not entirely inaccessible if other contextual cues like QUDs strongly point towards ECP-violating interpretations.
participants’ comments like (19). These highlight the role of lexical alternatives in shaping how the ECP bias manifests itself across different types of quantifiers.

(19)  a. The correct phrase should be ‘each pot might have a desert lotus shoot’. The word ‘every’ implies that all pots inclusively together have desert lotus shoots.  

b. The leaves on both kinds of plants have the same appearance. So it’s possible that any of the pots could have a lotus shoot. Though saying ‘every’ isn’t as clear as saying ‘any’.

For instance, (19a) suggests that each is a better choice than every for conveying $\forall \succ \Diamond$, most likely because each is associated with a stronger bias towards taking a wide scope than every; it is thus a less ambiguous option for signaling the intended meaning. The availability of each in conveying the ECP-violating proposition seems to give rise to additional pragmatic inferences that further strengthen the ECP bias associated with every. Listeners may reason that if the speaker had intended to convey the ECP-violating proposition, she likely would have used each. Since she opted for every instead, she most likely intends to convey the ECP-observing proposition (unless QUDs or other contextual information indicate otherwise).

As a final note, we may want to discuss what to make of the apparent discrepancy between the current experimental results (which highlight the defeasibility of the ECP) and the strong ECP intuitions initially reported in von Fintel and Iatridou (2003). There are various possible explanations for this. First, the implicit QUDs evoked by von Fintel and Iatridou (2003)’s examples might have been more along the line of How-QUDs than Which-QUDs. Second, providing explicit questions (which were absent in von Fintel and Iatridou (2003), although the contextual settings they introduced were fairly rich otherwise) along with the modal statements might have been the real game-changer and thus greatly boosted the availability of ECP violating interpretations in the experiment. Finally, the participants in the current experiment might have become more attuned to the latent ECP-violating scopal ordering through the course of their exposure to statements involving quantifiers and modals across multiple trials. The paper remains agnostic as to what could have been the most important source of the discrepancy. The main take-away seems to be that the ECP-violating interpretations cannot be entirely ruled out, although in many cases, diverse factors will conspire against them.

6. Conclusion

This paper presented an experimental study of the effects of explicit QUDs on the ECP. Based on the experimental results, it argued that the ECP can be recast as a gradient scopal preference which arises from a confluence of more primitive lexical and pragmatic biases.

References


7. *Appendix*

Links to all the experiments, data, and statistical models can be found at: https://github.com/sunwooj/ecp/
Experimenting with imposters: What modulates choice of person agreement in pronouns?1

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Abstract. Imposters are grammatically third-person expressions used to refer to the first-person speaker or second-person addressee (e.g. ‘the present authors’ when used to refer to the first-person writer, ‘Mommy’ or ‘Daddy’ when used by parents for self-reference in child-directed speech). Current analyses of imposters differ in whether they derive the unusual referential properties of imposters using syntactic means or attribute them to semantic and pragmatics. We aim to shed light on these competing approaches by means of a psycholinguistic experiment focusing on first-person imposters that investigates the kinds of pronouns (first-person vs. third-person) used to refer to imposter antecedents. Our results show that manipulating the prominence of the first-person speaker does not significantly boost the acceptability of first-person pronouns in imposter-referring contexts. However, our results suggest that a purely syntactic approach may not be sufficient either, as psycholinguistic processing factors also appear to be relevant.

Keywords: person agreement, agreement mismatch, pronoun, imposters, psycholinguistics, accessibility, prominence.

1. Introduction

Language often draws a sharp distinction between speaker, addressee and others in terms of the grammatical category of person. However, sometimes this neat division breaks down and third-person expressions are used to refer to the speaker or the addressee. This phenomenon is illustrated in (1a,b), where the speaker refers to themselves with expressions like ‘Grandma’ and ‘this reporter.’ These expressions occur with third-person verb agreement in English, but their intended interpretation is the first-person I (speaker).

(1)  a. Grandma needs to rest a bit! (said by grandmother to daughter)
    b. At the time, CBS News and this reporter fully believed the documents were genuine.
       (Dan Rather, talking about himself, from Collins and Postal, 2012:1)

These elements are often called imposters, which are defined by Collins and Postal (2012) as notionally first- or second-person DPs that are grammatically third person. More generally, an imposter can be defined as “A notionally X person DP that is grammatically Y person, X≠Y” (Collins and Postal, 2012:5). Thus, imposters’ grammatical person does not match their semantic or notional person (see also Collins, 2014 for a crosslinguistic discussion of imposters in a variety of languages).

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1 Many thanks to the audience at Sinn und Bedeutung for useful comments and feedback. We are grateful for funding from the Undergraduate Research Associates Program at the University of Southern California.
First-person and second-person imposters in English occur in a variety of contexts and registers, as exemplified in (1-3). As the examples show, imposters occur both in informal child-directed speech and in the more formal academic register. This phenomenon is not confined to a particular register.

(2) First-person imposters
   a. At the same time, the present authors had been asking ourselves whether there should be a model of cooperative governance (www.grocer.coop)
   b. The undersigned authorizes my student to participate in authorized DoDEA school study trips… (DoD Education Activity form)
   c. …the emphasis on restoring functions, as opposed to designing projects around the benefits themselves, seems sensible and appropriate to this reviewer. From my limited perspective… (http://tahoe.ca.gov/)

(3) Second-person imposters
   a. Would little Jimmie like another ice-cream cone? (Collins and Postal, 2012:7)
   b. How is my darling tonight? (Collins and Postal, 2012:7)

The structure of this paper is as follows: In Section 2, we review two competing views of imposters that differ in terms of how much of imposters’ unusual behavior is attributed to syntax vs. semantics and pragmatics. In Section 3, the person agreement properties of English singular and plural imposters are discussed. As we will see, English plural imposters can antecede both first- and third-person pronouns and reflexives, whereas singular imposters, at least in some contexts, appear to be limited to third-person pronouns. To further assess the acceptability of first- and third-person pronouns with imposter antecedents and to see whether increasing the prominence of the first-person speaker referent boosts the acceptability of first-person pronouns, we conducted a psycholinguistic experiment. The method and design are presented in Section 4, and the results are discussed in Section 5. Section 6 concludes the paper.

2. Two views of imposters

The split between imposters’ grammatical and notional properties—the fact that they seem to be grammatically third-person, at least when it comes to verb agreement in English, while being notionally first- or second person—poses challenges for theories of agreement. How can we capture this two-faced behavior of imposters? Broadly speaking, prior work has attributed the unexpected behavior of imposters either to (i) special syntactic properties of imposter DPs—what Collins and Postal (2012) call the syntactic view—or (ii) to special semantic or pragmatic properties of imposters—what Collins and Postal call the notional view.

One possibility is that imposters are syntactically normal third-person DPs (e.g. Baker, 2008; Siewierska, 2004; see also Stirling and Huddleston, 2002). Under this view, these grammatically third-person DPs are special in their interpretational/referential component, since they can refer to a first- or second-person referent. Under this view, any special agreement properties that imposters exhibit must stem from somewhere other than syntax—e.g. semantics / pragmatics / discourse—because syntactically, they are the same as normal
(non-imposter) third-person DPs. Collins and Postal (2012) refer to this approach as the notional view, and summarize it as follows:

(4) Notional view: “Imposters are syntactically regular 3rd person DPs with the semantic/discourse property that they denote either the speaker(s) (in the same sense as 1st person pronouns do) or the addressee(s) (in the same sense that 2nd person pronouns do).” (2012:78, emphasis in original)

Baker (2008) discusses examples like (5a,b) and states that “ordinal non-pronominal DPs are never first or second person, even when they refer to the speaker or hearer” (p.126).

(5) a. \([CP \text{ Si} [TP] [NP: The man who is/\*am talking to you] is hoping to get some money.]
   b. Sorry honey, but Daddy is/\*am too tired to play with you tonight.

According to Baker, a speaker-referring, first-person imposter like ‘the man who is talking to you’ can have the same index as the speaker (which he denotes with S in 5a). However, he describes this as “a definite description that refers to the speaker without being dependent on S” (Baker, 2008:127). In essence, under his account, imposters can refer to the speaker (i.e., can have the same index as the speaker) but are syntactically normal third-person DPs.

Using examples like (6a,b), Siewierska (2002) notes that expressions like ‘mummy’ and ‘Johnny’ can be used to refer to the speaker and the addressee, “but they cannot be said to express the discourse roles of speaker and addressee, as there is nothing in the words mummy and Johnny to suggest that they are speaker and addressee respectively” (Siewierska, 2002:2). She continues that “only I and you and not mummy and Johnny are expressions of the first and second persons” (Siewierska, 2002:2). Thus, according to Siewierska, imposters are grammatically third person, similar to Baker’s view (see also Stirling and Huddleston, 2002).

(6) a. I will spank you.
   b. Mummy will spank Johnny.

Siewierska notes that “In principle, there is no limit to the nature of the lexical expressions that a speaker may use to refer to herself” (Siewierska, 2002:2). However, Collins and Postal (2012) note that it is not the case that any third person DP can freely be interpreted as speaker-referring (or addressee-referring). For example, in (7a-b), ‘Uncle Carl’ cannot be an imposter, whereas in (7c) it can be interpreted as a first-person (speaker-referring) imposter. Thus, an open question for the notional view is what determines whether a DP can be interpreted as an imposter or not—i.e., in other words, what are the constraints that ensure that Uncle Carl can be interpreted as an imposter in (7c) but not in (7a-b).

(7) a. Are you Uncle Carl?
   b. Uncle Carl is my neighbor.
   c. Uncle Carl really needs to take a nap.

Collins and Postal (2012) argue against the notional view of imposters, and in favor of an analysis where the behavior of imposters stems from special syntactic properties. Under this view, the behavior of imposters is syntactically determined, and not due to semantics or
discourse (see also Collins, 2014). Simplifying considerably, the basic idea is that imposter DPs are structurally complex and include null indexical first (or second) person pronouns, in addition to the overt (visible) third-person DP. This plays a crucial role in allowing imposters to antecede both first-person and third-person pronouns, as exemplified in (8). Here, it seems that both themselves and ourselves are grammatical—i.e., the syntactically third-person imposter can antecede either a first-person or a third-person reflexive pronoun. (We discuss these patterns more in Section 3).

(8) Said by father to child:
Not now! Ask Auntie Jane to show you the garage. Daddy and Uncle Jim are enjoying {themselves/ourselves} on the beach. (adapted from Collins and Postal 2012)

More specifically, Collins and Postal (2012) analyze imposters as being derived from appositive precursor structures such as ‘we, the present writers’ or ‘I, your faithful correspondent’, such that imposter DPs have a null ‘core’ DP that expresses the notional first (or second) person pronoun as well as a visible DP that expresses the third-person form. For the purposes of the present paper, we assume that imposters (under the syntactic view) are indeed structurally complex, but the exact nature of that structure is not crucial for the claims we are making here.

A full summary of Collins and Postal’s system is beyond the scope of this paper, but crucially, it is a syntactically-defined system: The tension between the grammatical and notional person patterns of imposters is encoded in the structure of the imposters themselves by means of a covert indexical, and the person agreement patterns (Section 3) are derived by means of the syntactic notion of antecedence and the possibility of agreeing with both primary and secondary sources (syntactically defined).

3. Person agreement with imposters: Reflexives and possessive pronouns

Although English imposters consistently trigger third-person verb agreement (5), the person agreement patterns—as exhibited by reflexives and possessive pronouns—are less consistent. Specifically, it seems that plural imposters (e.g. the present authors) or coordinated imposters (e.g. Mommy and Daddy) can antecede both third- or first-person pronouns and reflexives, whereas singular imposters can only antecede third-person pronouns and reflexives (see also Collins and Postal, 2012; Collins et al., 2009; for a crosslinguistic overview, see Collins, 2014).

Let us first consider the data for plural imposters. As shown in (9), both third-person and first-person possessive pronouns and reflexives seem to be acceptable. In all cases in this paper, the intended interpretation is the one where the relevant pronoun or reflexive is coreferential with the imposter (i.e., does not refer to a third person). The possibility of using either first- or third-person reflexives is available with both ‘regular’ reflexives (9c) as well as inherent reflexives (9b). (We focus here on speaker-referring imposters and first-person pronouns, but the same observations and questions arise with addressee-referring imposters and second-person pronouns.)
(9)   a. Said by father to child:  
Mommy and Daddy need to take {their/our} shoes off first!  
b. Said by father to child:  
Not now! Ask Auntie Jane to show you the garage. Daddy and Uncle Jim are enjoying {themselves/ourselves} on the beach. (adapted from Collins and Postal 2012:114)  
c. Said/written by authors:  
In this reply, the present authors attempt to defend {themselves/ourselves} against the scurrilous charges which have been made (Collins and Postal 2012:vii)

Based on the first/third person alternation that is allowed by plural imposters, we might expect singular imposters to show the same flexibility when it comes to pronoun person agreement. However, the situation is less clear than one might expect. Collins and Postal note that singular imposters (e.g. Daddy, this reviewer) seem to require third person pronouns and reflexives. They report that first person pronouns and reflexives sound worse in these contexts. This intuition is supported by a small-scale experiment with fifteen participants conducted by Collins, Guitard and Wood (2009).

(10)   a. Said by father to child:  
Daddy needs to drink {his/*my} coffee first!  
b. Said by father to child:  
Not now! Ask Auntie Jane to show you the garage. Daddy is enjoying {himself/*myself} on the beach. (adapted from Collins and Postal, 2012)  
c. Said by a speaker who refers to himself as ‘this reporter’:  
This reporter sees himself/*myself as a managing editor in the future. (Collins and Postal, 2012:20)

However, as Collins and Postal (2012:20-21) acknowledge, there are also naturally-occurring examples from the web where singular posters antecede first-person anaphors, as illustrated in (11) (Examples cited by Collins and Postal, 2012).

(11)   a. This reviewer found myself frustrated at times with the various storylines (from an Amazon review)  
b. while yours truly treated myself to a few ice cold Miller Lites (from sportingnews.com)  
c. This reporter sent myself to cover Bill Clinton’s lecture at the Dorothy Pavilion (from www.louisepalanker.com)

Furthermore, Baker (2008:128) suggests that the acceptability of first-person pronouns with singular imposters may depend on whether imposter c-commands the pronoun. In the absence

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2 Collins & Postal distinguish imposters from what they call ‘camouflage DPs’ (see also Collins, Moody & Postal, 2008). One subclass of camouflage DPs are Social Hierarchy Camouflage Constructions such as your majesty, your honor. Collins & Postal (2012:74) note that in SHCC, the notional core is overt and occurs in possessor position: In your majesty, for example, the notional core is the second person addressee you (compare to yours truly or my lord, where the possessive pronoun does not match the notional referent). It seems that unlike imposters, camouflage DPs easily allow person alternation in the singular as well (ex.i). A discussion of why this is possible with camouflage DPs is beyond the scope of the present paper.  
i [Your majesty], should praise yourself, /herself/. (Collins, 2014:1)
of c-command, he reports that singular imposters can antecede first-person pronouns, and described (12a) with the first-person pronoun as “more or less possible” (p.128):

(12)  a. Father says: Because Daddy$_k$ forgot something at the office, he$_k$ has/I$_k$ have to go back there.  
     b. Father says: Daddy$_k$ has to go back to the office because he$_k$/I$_k$ forgot something there.

Thus, it is not yet well-understood (i) whether—or under what conditions and what syntactic configurations—singular imposters can antecede first-person pronouns, and (ii) why plural imposters seem to be able to antecede first-person pronouns more easily than singular imposters. Collins (2014) notes that “the singular/plural asymmetry with imposters remains a mystery, and accounting for it is one of the greatest challenges for future work” (Collins, 2014:24, see also Podobryaev, 2014; 2017 for related discussion of an asymmetry in the person feature assignment of plural vs. singular personal pronouns). Before considering the behavior of singular imposters in more depth, we consider how, according to Collins and Postal (2014), plural imposters can exhibit both first- and third-person agreement.

3.1. Multiple agreement options with plural imposters

How can plural imposters in English antecede both first- and third-person pronouns? Collins and Postal note that it is unclear how the notional view can capture these agreement patterns: If imposters are syntactically regular third-person DPs, it is unclear how they can bind first-person reflexive pronouns, if we assume that reflexives agree with their antecedents in terms of $\varphi$-features.

According to Collins and Postal (2012)’s syntactic view, the pronominal agreement patterns stem from the availability of more than one possible antecedent in the syntactic structure. They propose, building on prior work, that the left periphery contains null DPs for AUTHOR (aka Speaker) and ADDRESSEE. The AUTHOR DP is first person, and can be singular or plural (depending on the situation), and, correspondingly, the ADDRESSSEE DP is second person, and can also be singular or plural. The AUTHOR and ADDRESSSEE DPs are represented in an expanded left periphery (Rizzi 1997) or as arguments of a covert performative clause (Collins 2014, see also Speas and Tenny, 2003; Haegemann and Hill, 2013 on the Speech Act Projection). These null DPs are present even if the sentence does not contain first or second person pronouns.\footnote{However, some researchers argue against the syntactic encoding of speech-act-participant related projections at the left periphery (see e.g. Gärtner & Steinbach, 2006). In order to argue for a purely syntactic approach to imposters, the representation of AUTHOR (speaker) and ADDRESSSEE presumably needs to be syntactically encoded, so when discussing the syntactic view we treat them as null DPs in the left periphery.}

Crucially, to capture agreement patterns such as those in (9), Collins and Postal claim that a pronoun can agree with a primary or a secondary source. A full summary of their analysis is beyond the scope of this paper, but in essence, in (13), a pronoun can agree with (i)
AUTHOR as its ultimate antecedent, yielding first-person our (ex.13a) or ourselves (ex.13b) or with (ii) its immediate antecedent ‘Mommy and Daddy, yielding third-person their (ex.13a), or themselves (ex.13b). In this system, both the ultimate and immediate antecedent are defined as sources in configurations like (13) and thus pronominal agreement with either one is possible.

In contrast to proponents of the notional view, Collins and Postal claim that all pronouns (except expletives) have linguistic antecedents (Collins, 2014:4)–i.e., a first-person form like ‘our or ‘ourselves’ in (13) does not, under their approach, refer to an extra-linguistic referent but instead has a syntactically-present antecedent.

(13) a. [[DP AUTHOR] Mommy and Daddy need to finish {their/our} coffees first.]
   b. [[DP AUTHOR] Mommy and Daddy are enjoying {themselves/ourselves} on the beach.]

3.2. Choosing between multiple agreement options

The observation that plural imposters seem compatible with both first and third person agreement raises the question of what influences the choice of one over the other. Collins and Postal do not address this question in detail, and Akkuş (2017) notes that the choice of first vs. third-person pronoun does not correlate with truth-conditional differences. Indeed, if we assume a purely syntactic view of imposters, then both agreement options—(i) agreement with the ultimate AUTHOR antecedent and (ii) agreement with the immediate linguistically-overt third person antecedent—are equally available, as both are syntactically possible.

However, prior work on the general topic of pronoun use and interpretation (albeit mostly in in cross-clausal contexts with multiple possible antecedents) suggests that differences in antecedent accessibility/prominence guide pronoun interpretation. More specifically, many researchers have suggested that referents which are cognitively more accessible/prominent in language users’ minds at a particular point in the discourse are more likely to be chosen as antecedents of pronouns (e.g. Ariel, 1990; Gundel et al., 1993, and many others). Even though multiple referents can be activated in people’s mental representations of the discourse, some are more highly activated than others. Work on pronoun interpretation suggests that—other things being equal—pronouns tend to be interpreted as referring to the most salient referents.5 This might lead one to expect that in imposter structures such as (13), the pronoun will tend to agree with whichever antecedent—the ultimate AUTHOR (speaker) antecedent or the immediate ‘Mommy and Daddy’ antecedent—is more prominent.

But what influences the prominence/accessibility of potential antecedents? Work on cross-sentential pronoun interpretation has identified multiple factors, including (i) recency of mention (e.g. Givón, 1983)–more recently mentioned entities are more accessible/prominent than less-recently mentioned ones—as well as (ii) syntactic prominence–referents realized in subject position are more accessible/prominent than referents in other syntactic positions (e.g.

5 The salience/accessibility-based patterns observed in the pronoun resolution literature are gradient preferences and biases, not absolute principles or requirements.
Brennan et al., 1987). Various other factors such as verb semantics and discourse coherence have also been identified.

We conducted a psycholinguistic experiment designed to manipulate the prominence of the AUTHOR—in other words, the speaker of the sentence—to see if this influences people’s preference for first-person pronouns. We tested sentences where the main clause was (or was not) preceded by a subordinate clause—which we will call the ‘preamble’—that explicitly mentions the speaker(s) in subject position by means of a pronoun (ex.14).

(14) a. **Mommy and Daddy** have to finish {our/their} coffees.
    b. Before we take you to daycare, **Mommy and Daddy** have to finish {our/their} coffees.

In light of prior work showing that pronouns prefer prominent antecedents, combined with findings showing that recency of mention and realization in subject position boost referent prominence, we might expect first person pronouns to be more likely in (14b) than in (14a)—or in terms of acceptability, we may find that participants rate (14b) with our as more acceptable or natural than (14a) with our. Third-person pronouns are presumably equally acceptable in both contexts, as they match the grammatical third-person status of the imposter.

3.3. Singular imposters: Acceptability of first-person vs. third-person pronoun

In addition to testing plural imposters (ex.14a,b), we also investigated singular imposters, to gain more clarity into whether they can antecede first-person pronouns in addition to third-person pronouns. Collins and Postal (2012) report first-person pronouns as being ungrammatical with singular imposters, but acknowledge that corpus examples with first-person pronouns exist (see (11)). A small-scale study by Collins et al. (2009) tested an item in a configuration where a possessive first- or third-person pronoun (in an idiomatic, inalienable-possesion construction, ‘lose my/his cool’) refers to a singular imposter (‘this reporter’) and obtained an average rating of 1.573 out of a maximum rating of 3. Although it is not yet clear if this pattern will generalize to other sentences and other types of possession relations, it further highlights the unclear status of pronoun patterns with singular imposters. In addition, Baker (2008) notes that presence vs. absence of c-command may play a role. In sum, the status of singular imposters anteceding first-person pronouns in English is not clear.

Thus, we investigated whether the presence of a preamble clause that mentions the AUTHOR by means of the first-person pronoun “I” in subject position makes first-person pronouns more acceptable in sentences like (15). If the choice of a first-person vs. third-person pronoun is modulated by the accessibility/prominence of the first-person AUTHOR—a prediction compatible with the notional view but one that does not follow from the syntactic view—we expect to effects of the presence/absence of the preamble clause.

(15) a. **Mommy** has to finish {my/her} coffee.
    b. Before I take you to daycare, **Mommy** has to finish {my/her} coffee.
4. Experiment

We conducted an acceptability-rating experiment to investigate (i) whether the acceptability of first-person vs. third-person pronouns with third-person imposters is modulated by the prominence/salience of the AUTHOR antecedent and to (ii) test whether singular imposters can antecede both first- and third-person pronouns and (iii) whether this is influenced by the prominence of the AUTHOR antecedent. We tested the acceptability of first-person and third-person possessive pronouns with plural and singular imposter antecedents, with and without preamble clauses that mention the AUTHOR by means of an overt first-person pronoun.

We tested possessive pronouns rather than reflexive pronouns, because it was easier to generate a large number of target sentences with possessives without needing to use lower-frequency or more marked verbs which might inadvertently catch participants’ attention or sound unusual for reasons orthogonal to imposters. In all of our critical sentences, the imposter NP c-commands the possessed noun, as shown in (13-14).°

4.1. Method

4.1.1. Participants

Forty adult native English speakers from the University of Southern California community participated.

4.1.2. Materials and design

We manipulated (i) number (singular and plural imposters and pronouns), (ii) person (first and third person pronouns) and (iii) context (presence/absence of preamble clause that mentions the speaker/AUTHOR). The subject of the sentence was either a singular third-person imposter (e.g. Mommy, Grandpa) or a coordinated DP yielding a plural (e.g. Mommy and Daddy). Thus, the plurals we tested were all coordinated structures. The possessive pronouns were correspondingly either singular or plural—and, crucially, either first-person (my, our) or third person (her/his, their). In addition to manipulating person and number, we also manipulated the context—specifically, whether or not the main clause was preceded by a temporal clause containing a first-person pronoun (I, we) that refers to the speaker (AUTHOR). This yields a 2x2x2 design (8 conditions, presented with a standard Latin-Square design). The experiment included 32 target items and 36 filler items. The imposters used in targets and fillers included terms referring to parents (Mom, Dad, Mommy, Daddy) and grandparents (Grandma, Grandpa).

° As mentioned above, Baker (2008) suggests that configurations where the imposter does not c-command the pronoun may be more likely to allow first-person pronouns with third-person imposters. We did not investigate non-c-command configurations in our work, and leave this as a question for future research.
In this experiment, we used parent- and grandparent-referring imposters in child-directed speech. This is because pre-testing showed that college-aged U.S. English speakers (i.e., the group that our participants belong to) are familiar with this type of imposter use. In future work, we plan to explore imposters in more formal academic registers, such as “the present authors,” after ensuring that we can identify enough participants familiar with this usage.

All targets and fillers were preceded with information about who says the sentence to whom, as illustrated in (16). This is important as it ensures that the relevant nouns are interpreted as imposters, rather than ‘normal’ nouns referring to third-person, non-speaker referents. To encourage participants to attend to the clause indicating who says the sentence, they were asked open-ended recall questions during the experiment about who said the preceding sentence, and had to answer these questions without seeing the sentence again.

(16a) NoContext_ SG_3
Father says to child: 
Daddy has to finish **his** coffee.

NoContext_ SG_1
Father says to child: 
Daddy has to finish **my** coffee.

(16b) Context_SG_3
Father says to child: 
Before I take you to daycare, Daddy has to finish **his** coffee.

NoContext_ SG_1
Father says to child: 
Before I take you to daycare, Daddy has to finish **my** coffee.

(16c) NoContext_PL_3
Father says to child: 
**Daddy and Mommy** have to finish **their** coffees.

NoContext_PL_1
Father says to child: 
Daddy and Mommy have to finish **our** coffees.

(16d) Context_PL_3
Father says to child: 
Before we take you to daycare, **Daddy and Mommy** have to finish **their** coffees.

Context_PL_1
Father says to child: 
Before we take you to daycare, **Daddy and Mommy** have to finish **our** coffees.

When designing the stimuli, we aimed to minimize the likelihood that a first-person plural possessive could be construed as referring to possession involving the addressee (child) in
addition to the parents/grandparents. This is important, because we want to probe whether first-person pronouns can be anteceded specifically by the imposter. Thus, we wanted to avoid situations where the addressee is also one of the possessors, as this could trigger use of first-person plural ‘our,’ as illustrated in (17).

(17) *Anne says to Beth*: Carla needs to pack our *Anne’s + Beth’s* bags.

Thus, we used possessives such as ‘their/our coffees’ or ‘their/our work shirts’—i.e., things that are likely to be possessed only by the parents or grandparents—and tried to avoid joint family objects such as ‘our car’ or ‘our house’ whose ownership could also involve the child.

In addition to 32 targets, the study also included 36 filler items. The fillers were also presented as said by a parent or grandparent to a child, and some of them also contained imposters. However, unlike targets, the fillers did involve possessive constructions where the possessor refers to the imposter. The fillers were designed to elicit a range of acceptability judgments.

4.1.3. Procedure

Investigating coreference judgements by means of psycholinguistic experiments with naïve participants can be challenging. The term ‘coreference’ is not familiar to non-linguists, and introducing notation such as coindexing can be confusing. In our experiments, we build on the seminal paper of Gordon and Hendrick (1997). They report a series of six experiments on Binding Theory that investigate the coreference judgments of native English speakers who are “naïve to contemporary syntactic theory” (Gordon and Hendrick, 1997:325). Following Gordon and Hendrick, we presented our participants with sentences where certain words were bolded and underlined, and asked them to rate the acceptability of the sentence when those two words refer to the same person or thing. On target trials, the subject, the possessive pronoun and, if a preamble clause was present, the first-person pronoun in preamble, were bold and underlined. (See 14-16). All text was in black font.

Participants were instructed to rate how acceptable each sentence sounds if the bolded and underlined expressions refer to the same person or thing, using a five-point scale (1 = completely unacceptable, 5 = completely acceptable). Gordon and Hendrick (1997) successfully used this kind of method (both with binary yes/no responses and with a six-point scale) for probing acceptability of coreference when investigating people’s judgements of Binding Principles A and B. In subsequent work, Keller and Asudeh (2001) set out to replicate some of Gordon and Hendrick’s results using a similar method, except with the critical words presented in capitals rather than bold font, and using Magnitude Estimation rather than a binary yes/no acceptability response or a Likert-scale type response. They

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7 Gordon and Hendrick (1997) used bold font without underlining. Keller and Asudeh (2001) showed that using words in ALL CAPITALS without bold font also works (see also Collins et al. 2009 on using + before and after words, e.g. +herself+). We used both bold font and underlining (but no capitals) because on some modern fonts, boldface by itself is not very distinctive. We wanted to ensure that there was no confusion about which words were bolded and underlined.
successfully replicated Gordon and Hendrick’s results, further confirming that this kind of task can be successfully used to test coreference judgements in an experimental setting.

In our study, before the main experiment, the experimenter discussed a series of example items with the participant, to ensure that participants understand the task. Participants were also told that a colloquial tone/register should not be interpreted as unacceptable, because we did not want the informal tone of child-directed speech to be judged negatively. In addition, to ensure that the first-person “I” or “we” in the preambles is interpreted as intended, we also included example items which showed that in sentences with three bolded and underlined words, participants should consider all three and should only rate a sentence as acceptable if all three can refer to the same person or thing.

The filler items in the study were designed so that in some, the bolded and underlined words were coreferential (expected rating on the five-point scale is high); in others, the bolded and underlined words could not corefer (expected rating is low); and in some others, the bolded and underlined words could be construed as coreferential but did not need to be. This was done to prevent participants from developing a response strategy or a default bias for one kind of response.

4.2. Predictions

According to the **syntactic view**, both the local and the ultimate (AUTHOR) antecedent are syntactically equally available to antecede the possessive pronoun. Thus, the discourse salience/prominence of the speaker/ultimate antecedent is not expected to have any effect on pronominal agreement, and both third-person and first-person pronouns are predicted to be equally acceptable, at least with plural imposters. Thus, under this view, (i) the presence/absence of the preamble clause is not expected to influence acceptability judgements, and (ii) the pronoun manipulation (first vs. third person) is also not expected to influence acceptability of plural imposters. The situation is less clear for singular imposters: Collins and Postal (2012) judge singular imposters to be ungrammatical with first person pronouns, but others disagree. Thus, it is not clear whether we should expect an interaction between number and pronoun person.

According to the **notional view**, imposters are syntactically normal third-person DPs and their special referential behavior stem from their semantic or pragmatic properties. Under this approach, one might well find that in a context where the first-person AUTHOR (the speaker of the sentence) is very prominent, due to having been recently mentioned in subject position with a first-person pronoun, we may find that first-person pronouns are judged to be more acceptable than in a context where the AUTHOR is less prominent. In other words, we may find an interaction between presence/absence of preamble clause and whether the pronoun is first or third person: The third-person pronoun will (presumably) be acceptable in all contexts, as it matches the ‘surface form’ of the imposter, whereas the first-person pronoun may be more acceptable in the presence of the AUTHOR-boosting preamble clause. It is important to acknowledge that the notional view does not explicitly predict an effect of the presence/absence of the AUTHOR-mentioning preamble clause, but would be more compatible with such a finding than the syntactic view would. As regards potential
differences between plural vs. singular imposters, the notional view (at least a simple version thereof) does not straightforwardly lead us to expect any differences based on number.

5. Results and discussion

Figure 1 shows the average acceptability ratings for each of the eight conditions. The data were analyzed using mixed-effect regression models (lmer, R, R Core Team, http://www.R-project.org/). Following a widespread convention, effects are reported as significant when \(|t| \geq 2\).

![Figure 1](image_url)

Figure 1. Mean acceptability ratings in each condition, based on a five-point scale (1=completely unacceptable, 5=completely acceptable. Error bars show +/- 1 SE.

5.1 Singular imposters: Comparing first- and third-person pronouns

Let us first consider the left half of the figure, which shows the conditions with singular imposters (with singular first- or third-person pronouns). Conditions with third-person pronouns are rated significantly more acceptable than conditions with first-person pronouns: More specifically, Context_SG_3 is rated significantly more acceptable than Context_SG_1, and NoContext_SG_3 is rated significantly more acceptable than NoContext_SG_1. This shows that, both with and without an AUTHOR-boosting preamble clause, people significantly prefer third-person pronouns with singular imposters over first-person pronouns.

One of the questions we posed at the start of the paper is whether first-person pronouns are acceptable with imposter antecedents or not. It is important to keep in mind that a five-point scale does not allow us to directly determine whether a certain sentence is grammatical or
ungrammatical. Although sentences with singular imposters that antecede first-person pronouns are judged less grammatical than the third-person variants, their average ratings are nevertheless between 2.5 and 3 on the five-point scale (as can be seen in the figure), and thus around the midpoint of the scale (3). A five-point scale does not allow us to identify specific cut-offs for grammatical vs. ungrammatical sentences, but the fact that our study yielded ratings near the mid-point of the scale—as opposed to ratings averaging around 1—suggests that first-person pronouns anteceded by imposters are not strikingly ungrammatical but are significantly less acceptable/less grammatical than third-person pronouns.

As a whole, these findings are in line with the intuitions, reported in prior work, that third-person pronouns are the default option for singular imposters in English, and that first-person pronouns are more marked.

5.2. Plural imposters: Comparing first- and third-person pronouns

Turning now to the right half of the figure, which shows the conditions with plural imposters, it is immediately clear that overall ratings are relatively high in all plural-pronoun conditions: All means are 4 or higher, on the five-point scale. Statistical analyses show that the Context_PL_3 and Context_PL_1 conditions do not differ significantly from each other: With an AUTHOR-boosting preamble clause that mentions ‘we’, sentences where an imposter antecedes ‘our’ are rated equally acceptable as sentences with ‘their’. Thus, the first vs. third person asymmetry observed with singular imposters is absent here.

In conditions with no preamble clause, we find that NoContext_PL_3 is rated as significantly more acceptable than NoContext_PL_1 (|t|>2.8). We say more about this below. For now, suffice it to say that in the NoContext condition, sentences where the pronoun agrees with the local, linguistically overt antecedent (third person) are rated as significantly more acceptable than sentences where the pronoun agrees with the ultimate AUTHOR antecedent (first person).

5.3. Effects of the AUTHOR-boosting context manipulation?

What about effects of context? Here, our specific question concerns the conditions with first-person pronouns, because we want find out whether the presence of an AUTHOR-boosting preamble sentence improves the acceptability of first-person pronouns with imposters. Acceptability of third-person pronouns is not under debate (as prior work agrees that English imposters can antecede third-person pronouns). We also do not expect acceptability of third person pronouns to benefit from the presence of a first-person/AUTHOR-boosting context.

With singular imposters and first-person pronouns, we find no effects of the context manipulation: The presence of an AUTHOR-boosting preamble clause does not make sentences with first-person pronouns significantly more acceptable than their contextless counterparts (Context_SG_1 and NoContext_SG_1), though—intriguingly—the effect is numerically in the right direction. Context_SG_1 is rated numerically as more acceptable than NoContext_SG_1 (t=1.845, where |t|=2 is widely viewed as the minimum threshold for
significance). Despite these hints of a potential context boost, the conditions with first-person singular pronouns receive the lowest ratings out of all eight conditions.

With plural imposters and first-person plural pronouns (Context_PL_1 and NoContext_PL_1), statistical analyses show no effect of the context manipulation, which is expected based on the patterns in Figure 1: Both conditions receive ratings around 4.5, regardless of the presence or absence of the AUTHOR-boosting clause.

What about sentences with third-person pronouns? Recall that the third-person conditions are not crucial to our AUTHOR-boosting hypothesis, which focuses on the acceptability of first-person pronouns. Nevertheless, if we look at how the presence/absence of the preamble clause influences sentences with third-person pronouns, statistical analyses reveal that with both singular and plural imposters, we find that sentences with (singular or plural) third-person pronouns are rated higher in the NoContext than Context conditions (|t|’s>3). This is presumably because the Context conditions with the AUTHOR-boosting preamble clause with the first person pronoun “we” involve a clash between the first-person pronoun in the preamble clause and the third-person pronoun in the second clause, which decreases acceptability.

Overall, the presence of an AUTHOR-mentioning preamble clause does not increase acceptability in any condition: Either we find no significant effects (with singular imposters) or we find effects in the opposite direction (with plural imposters).

5.4 Implications for theoretical accounts of imposters

The finding that explicit mention of the AUTHOR by means of a subject-position first-person singular or plural pronoun does not boost the acceptability of first-person pronouns with imposter antecedents goes against the hypothesis we formulated on the basis of the notional view and existing work on reference resolution.

However, other aspects of our results pose challenges for the syntactic view. One challenge comes from the finding that in plural pronoun conditions without a context clause, the linguistically overt third-person antecedent is the preferred target for agreement—i.e., sentences with third person possessive pronouns are rated as more acceptable than sentences with first person possessive pronouns. This is unexpected under the syntactic view, which posits that both the first person AUTHOR (ultimate antecedent) and the third person immediate antecedent are available. Indeed, the finding that the linguistically local, overt antecedent is preferred over the covert, notional antecedent—which, according to Collins and Postal (2012), is represented by a null DP in the left periphery—suggests that processing factors related to locality (the ultimate AUTHOR antecedent is less local) as well as overtness (the AUTHOR DP is not linguistically overt) may be at play. This suggests that a purely syntactic approach by itself is likely to be insufficient. Broadly speaking, locality-based effects are widely observed in different domains of language processing, and prior work has also found that different referring forms have consequences for the subsequent prominence of their referents, so it would not be surprising to find similar effects here.
Furthermore, another potential challenge for a purely syntactic approach to imposter agreement comes from the finding that in conditions with a preamble mentioning the first-person AUTHOR by means of “we”, use of the third-person pronoun “their” elicits lower acceptability ratings than use of first-person “our”. We suggest that this may be due to the person mismatch between “we” and “their”: In a context where a first-person pronoun has been established (by the preamble) as the discoursally-preferred means of referring to the imposter, switching to a third-person pronoun is dispreferred—even though the third-person pronoun matches the ‘surface form’ of the imposter. Under a purely syntactic account, something more would need to be said in order to explain how such a person clash would impact acceptability, given that both first- and third-person antecedents are available for the possessive pronoun to agree with.

6. Conclusions

In this paper, we investigated the agreement properties of imposters—expressions that are grammatically third-person but are used to refer to the first-person speaker or the second-person addressee (e.g. Mommy’ or ‘Daddy’ when used by parents for first-person self-reference in child-directed speech). Current analyses of imposters differ in whether they derive the referential properties of imposters using syntactic means (the syntactic view) or attribute them to semantic and pragmatics (the notional view).

In this paper, we took some initial steps to shed light on these competing approaches by means of a psycholinguistic experiment, focusing on first-person imposters. We tested the acceptability of first-person vs. third-person pronouns used to refer to singular and plural imposter antecedents, and also manipulated the discourse accessibility of the first-person speaker by means of a preamble clause.

We tested whether boosting the prominence of the first-person AUTHOR (speaker of the sentence) by explicit mention by means of “I” or “we” makes subsequent first-person pronouns more acceptable with imposter antecedents. A purely syntactic view of imposters does not directly lead us to expect any effects of this prominence-boosting approach. In contrast, although prominence/accessibility is not explicitly discussed by prior proponents of the notional view, potential, prominence-boosting effects would be compatible with that approach.

Our results suggest that manipulating the prominence of the first-person speaker does not significantly boost the acceptability of first-person pronouns in imposter-referring contexts, although we observe hints of numerical effects in the predicted direction with singular imposters. Furthermore, our results suggest that a purely syntactic approach may not be sufficient either, as psycholinguistic processing factors related to locality and the null/overt distinction also appear to be relevant. However, further work is necessary to better understand the effects, and this is an important direction for future work. In light of prior psycholinguistic work on locality effects and consequences of referential form for referent prominence, our findings point to a close interplay between processing factors and syntactic representations.
References


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# Table of Contents

## Volume 1

<table>
<thead>
<tr>
<th>Chapter</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foreword</td>
<td>i</td>
</tr>
<tr>
<td>Table of Contents</td>
<td>iii</td>
</tr>
<tr>
<td><strong>Márta Abrusán, Nicholas Asher and Tim Van de Cruys</strong></td>
<td></td>
</tr>
<tr>
<td><em>Content vs. function words: The view from distributional semantics</em></td>
<td>1</td>
</tr>
<tr>
<td><strong>Dorothy Ahn</strong></td>
<td></td>
</tr>
<tr>
<td><em>Korean classifier-less number constructions</em></td>
<td>23</td>
</tr>
<tr>
<td><strong>Sascha Alexeyenko</strong></td>
<td></td>
</tr>
<tr>
<td><em>Quantification in event semantics: Generalized quantifiers vs. sub-events</em></td>
<td>39</td>
</tr>
<tr>
<td><strong>Pranav Anand and Natasha Korotkova</strong></td>
<td></td>
</tr>
<tr>
<td><em>Acquaintance content and obviation</em></td>
<td>55</td>
</tr>
<tr>
<td><strong>Pranav Anand and Maziar Toosaryandani</strong></td>
<td></td>
</tr>
<tr>
<td><em>No explanation for the historical present: Temporal sequencing and discourse</em></td>
<td>73</td>
</tr>
<tr>
<td><strong>Curt Anderson and Sebastian Lübner</strong></td>
<td></td>
</tr>
<tr>
<td><em>Roles and the compositional semantics of role-denoting relational adjectives</em></td>
<td>91</td>
</tr>
<tr>
<td><strong>Muriel Assmann, Daniel Büring, Izabela Jordanoska and Max Prüller</strong></td>
<td></td>
</tr>
<tr>
<td><em>Focus constraints on ellipsis — An unalternatives account</em></td>
<td>109</td>
</tr>
<tr>
<td><strong>Corien Bary, Daniel Altshuler, Kristen Syrett and Peter De Swart</strong></td>
<td></td>
</tr>
<tr>
<td><em>Factors licensing embedded present tense in speech reports</em></td>
<td>127</td>
</tr>
<tr>
<td><strong>Itai Bassi and Ezer Rasin</strong></td>
<td></td>
</tr>
<tr>
<td><em>Equational-intensional relative clauses with syntactic reconstruction</em></td>
<td>143</td>
</tr>
<tr>
<td>Title</td>
<td>Page</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------</td>
</tr>
<tr>
<td>Andrea Beltrama</td>
<td></td>
</tr>
<tr>
<td>Subjective assertions are weak: Exploring the illocutionary profile of perspective-dependent predicates</td>
<td>161</td>
</tr>
<tr>
<td>Andrea Beltrama, Erlinde Meertens and Maribel Romero</td>
<td></td>
</tr>
<tr>
<td>Decomposing cornering effects: an experimental study</td>
<td>175</td>
</tr>
<tr>
<td>Anton Benz, Carla Bombi and Nicole Gotzner</td>
<td></td>
</tr>
<tr>
<td>Scalar diversity and negative strengthening</td>
<td>191</td>
</tr>
<tr>
<td>Anton Benz, Nicole Gotzner and Lisa Raithel</td>
<td></td>
</tr>
<tr>
<td>Embedded implicature in a new interactive paradigm</td>
<td>205</td>
</tr>
<tr>
<td>M. Ryan Bochnak and Martina Martinovi[Pleaseinsertintopreamble]</td>
<td></td>
</tr>
<tr>
<td>Modal height and modal flavor: The case of Wolof di</td>
<td>223</td>
</tr>
<tr>
<td>David Boylan</td>
<td></td>
</tr>
<tr>
<td>Miners and modals</td>
<td>241</td>
</tr>
<tr>
<td>Saskia Brockmann, Sara McConnell, Valentine Hacquard and Jeffrey Lidz</td>
<td></td>
</tr>
<tr>
<td>Children's comprehension of pronouns and definites</td>
<td>259</td>
</tr>
<tr>
<td>Sebastian Bücking</td>
<td></td>
</tr>
<tr>
<td>Painting cows from a type-logical perspective</td>
<td>277</td>
</tr>
<tr>
<td>Nattanun Chanchaochai</td>
<td></td>
</tr>
<tr>
<td>On acquiring a complex personal reference system: Experimental results from Thai children with autism</td>
<td>295</td>
</tr>
<tr>
<td>WooJin Chung</td>
<td></td>
</tr>
<tr>
<td>Context updates in head-final languages: Linear order or hierarchy?</td>
<td>313</td>
</tr>
<tr>
<td>Ava Creemers, Jérémy Zehr and Florian Schwarz</td>
<td></td>
</tr>
<tr>
<td>Interpreting presuppositions in the scope of quantifiers: Every vs. at least one</td>
<td>331</td>
</tr>
<tr>
<td>Virginia Dawson</td>
<td></td>
</tr>
<tr>
<td>A new kind of epistemic indefinite</td>
<td>349</td>
</tr>
<tr>
<td>Michael Deigan</td>
<td></td>
</tr>
<tr>
<td>Counterfactual donkeys don’t get high</td>
<td>367</td>
</tr>
<tr>
<td>Maria Esipova</td>
<td></td>
</tr>
<tr>
<td>Focus on what’s not at issue: Gestures, presuppositions, appositives under contrastive focus</td>
<td>385</td>
</tr>
<tr>
<td>Danny Fox</td>
<td></td>
</tr>
<tr>
<td>Partition by exhaustification: Comments on Dayal 1996</td>
<td>403</td>
</tr>
<tr>
<td>Title</td>
<td>Authors</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>--------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>The processing cost of Downward Entailingness: the representation</td>
<td>Yosef Grodzinsky, Galit Agmon, Kedem Snir, Isabelle Deschamps and Yonatan Loewenstein</td>
</tr>
<tr>
<td>and verification of comparative constructions</td>
<td></td>
</tr>
<tr>
<td>Linguistic barriers to logical reasoning: a new perspective on</td>
<td>Andreas Haida, Luka Crnić and Yosef Grodzinsky</td>
</tr>
<tr>
<td>Aristotelian syllogisms</td>
<td></td>
</tr>
<tr>
<td>A comparison of fei and aber</td>
<td>Stefan Hinterwimmer and Cornelia Ebert</td>
</tr>
<tr>
<td>QUD effects on epistemic containment principle: An experimental</td>
<td>Sunwoo Jeong</td>
</tr>
<tr>
<td>study</td>
<td></td>
</tr>
<tr>
<td>Experimenting with imposters: What modulates choice of person</td>
<td>Elsi Kaiser, Justin Nichols and Catherine Wang</td>
</tr>
<tr>
<td>agreement in pronouns?</td>
<td></td>
</tr>
<tr>
<td>Counteridenticals and dream reports: A unified analysis</td>
<td>Carina Kauf</td>
</tr>
<tr>
<td>A formal pragmatic account of Double Access</td>
<td>Peter Klecha</td>
</tr>
<tr>
<td>Hard cases of third readings in terms of the Standard Solution</td>
<td>Petr Kusliy and Ekaterina Vostrikova</td>
</tr>
<tr>
<td>Questioning speech acts</td>
<td>Jess H.-K. Law, Haoze Li and Diti Bhadra</td>
</tr>
<tr>
<td>Distinguishing coercion and underspecification in Type Composition</td>
<td>Julia Lukassek and Alexandra Anna Spalek</td>
</tr>
<tr>
<td>Logic</td>
<td></td>
</tr>
<tr>
<td>Degrees as nominalized properties: Evidence from differential verbal</td>
<td>Qiongpeng Luo and Zhiguo Xie</td>
</tr>
<tr>
<td>comparatives in Mandarin Chinese</td>
<td></td>
</tr>
<tr>
<td>Time in probabilistic causation: Direct vs. indirect uses of lexical</td>
<td>Fabienne Martin</td>
</tr>
<tr>
<td>causative verbs</td>
<td></td>
</tr>
<tr>
<td>On competing degree morphemes in verbs of change in Southern Aymara</td>
<td>Gabriel Martínez Vera</td>
</tr>
<tr>
<td>VOLUME 2</td>
<td></td>
</tr>
<tr>
<td>Author(s)</td>
<td>Title</td>
</tr>
<tr>
<td>--------------------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Melania S. Masià</td>
<td>Extreme nouns and maximizers</td>
</tr>
<tr>
<td>Jon Ander Mendia</td>
<td>Some kind of relative clause</td>
</tr>
<tr>
<td>Ralf Naumann, Wiebke Petersen and Thomas Gamerschlag</td>
<td>Underspecified changes: a dynamic, probabilistic frame theory for verbs</td>
</tr>
<tr>
<td>Pritty Patel-Grosz, Patrick Georg Grosz, Tejaswinee Kelkar and Alexander Refsum Jensenius</td>
<td>Coreference and disjoint reference in the semantics of narrative dance</td>
</tr>
<tr>
<td>Ethan Poole</td>
<td>Constraining (shifting) types at the interface</td>
</tr>
<tr>
<td>Claudia Poschmann</td>
<td>Embedding non-restrictive relative clauses</td>
</tr>
<tr>
<td>Claudia Poschmann, Sascha Bargmann, Christopher Götze, Anke Holler, Manfred Sailer, Gert Wehelhuth and Thomas Ede Zimmermann</td>
<td>Split-antecedent relative clauses and the symmetry of predicates</td>
</tr>
<tr>
<td>Tom Roberts</td>
<td>Responsive predicates are question-embedding: Evidence from Estonian</td>
</tr>
<tr>
<td>Vincent Rouillard and Bernhard Schwarz</td>
<td>Presuppositional implicatures: quantity or maximize presupposition?</td>
</tr>
<tr>
<td>Yağmur Sağ</td>
<td>The semantics of Turkish numeral constructions</td>
</tr>
<tr>
<td>Hiroaki Saito and Adrian Stegovec</td>
<td>The pa/wa of imperative alternatives</td>
</tr>
<tr>
<td>Katrin Schulz</td>
<td>The similarity approach strikes back: Negation in counterfactuals</td>
</tr>
<tr>
<td>Bernhard Schwarz and Alexandra Simonenko</td>
<td>Decomposing universal projection in questions</td>
</tr>
<tr>
<td>Radek Šimík</td>
<td>Ever free relatives crosslinguistically</td>
</tr>
<tr>
<td>Ryan Walter Smith and Ryoichiro Kobayashi</td>
<td>Alternating conj/disjunctions: the case of Japanese -toka and -tari</td>
</tr>
<tr>
<td>Author(s)</td>
<td>Title</td>
</tr>
<tr>
<td>---------------------------</td>
<td>----------------------------------------------------------------------</td>
</tr>
<tr>
<td>Frank Sode</td>
<td>good as a predicate of worlds</td>
</tr>
<tr>
<td>Chao Sun and Richard Breheny</td>
<td>Shared mechanism underlying unembedded and embedded enrichments: Evidence from enrichment priming</td>
</tr>
<tr>
<td>Robert Van Rooij</td>
<td>Generics and typicality</td>
</tr>
<tr>
<td>Jérémy Zehr and Florian Schwarz</td>
<td>Returning to non-entailed presuppositions again</td>
</tr>
<tr>
<td>Linmin Zhang</td>
<td>Enough, too, and causal dependence</td>
</tr>
<tr>
<td>Sarah Zobel</td>
<td>An analysis of the semantic variability of weak adjuncts and its problems</td>
</tr>
</tbody>
</table>
Counteridenticals and dream reports: A unified analysis

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Abstract. Counteridenticals are counterfactual conditional sentences whose antecedent clauses contain an identity statement, e.g. If I were you, I’d buy the blue dress. Here, we argue that counteridenticals are best analyzed along the lines of dream reports. After showing that counteridenticals and dream reports exhibit striking grammatical and perceptual parallels, we suggest an analysis of counteridenticals with Percus and Sauerland’s (2003) analysis of dream reports. Following their proposal, we propose to make use of concept generators, realized as centered worlds. To this end, we argue that the presence of if licenses the presence of an imagine-operator, which constitutes the attitude the antecedent clause ‘x be-PAST y’ is taken under; The speaker predicates, in the imagine mode, the consequent property to his/her imagined self. To capture the different degrees of identification between the subject and the predicate of the identity statement of counteridenticals’ antecedents observed in the literature, we incorporate Percus and Sharvit’s (2014) notion of asymmetric be into the analysis. This proposal has several advantages over existing analyses (Lakoff, 1996; Kocurek, 2016) of counteridentical meaning, as it both explains the different degrees of identification observed for counteridenticals and correctly predicts the parallels between counteridenticals and dream reports.

Keywords: Counteridenticals, counterfactuals, dream reports, pronoun movement

1. Introduction

Counteridenticals are conditionals with the following two properties: First and foremost, they are counterfactual conditionals, meaning that the propositions embedded in their antecedent clauses do not hold in the actual world. Nevertheless, counteridenticals do not just constitute any kind of counterfactuals but rather a specific subtype: Their antecedent clauses always embed an identity statement which identifies two inherently incompatible entities with each other. Examples of counteridenticals are given in (1) and (2): We know that, in the real world, the meaning of the expression ‘Paula’ is unlike the meaning of ‘Angela Merkel’, and likewise for ‘I’ and ‘you’. Yet, these expressions are felicitously identified with each other in the antecedent of counteridenticals:

(1) If I were you, I’d buy the blue dress.
(2) If Paula were Angela Merkel, she’d be the chancellor of Germany.

From the above examples we derive the following intuitive meaning of counteridenticals, and it is the aim of this paper to capture it in formal terms: A speaker is imagining a counterfactual world. In this contrary-to-fact world, the subject and the predicate entities of the antecedent clause have been identified with each other, leading to the creation of a counterpart of the

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subject entity in the counterfactual world. According to Lewis (1973), the counterpart of an entity is a non-actual individual who is not the same individual as the actual entity itself but similar enough to it such that the reference across worlds is rigid. For counteridenticals, we gather that the counterpart belongs to the subject entity since sentences like (3) are marginal for native speakers of English and, thus, will not be considered in this paper.

(3) /* If I were Angela Merkel, her name would be Carina.

The counterpart entity that lives in a counteridentical world is a composed individual—it contains properties of both the antecedent clause’s subject and predicate entity, i.e. the referents of the clause’s subject and predicate. This becomes evident when considering scenarios like the following: Imagine that we are dress shopping. I like the blue dress best, but I do not have the money to buy it. You, on the other hand, have the money to buy it, but you like the red dress better. In this scenario, neither you nor I would buy the blue dress in the actual world. Nevertheless, if you asked me which dress you should buy in the given scenario, I could felicitously utter “If I were you, I’d buy the blue dress”, to express that a non-actual counterpart of mine—having my taste in clothing but your financial situation—would buy the blue dress. Hence, the consequent propositions of counteridenticals are evaluated with respect to a composed counterpart individual that possesses a set of contextually relevant properties derived from the subject and predicate entities.

In this paper, we argue contrary to existing proposals of counteridentical meaning (Lakoff, 1996; Kocurek, 2016) that counteridenticals are best analyzed along the lines of dream reports, which already receive a similar intuitive interpretation as counteridenticals: Also when dreaming, we may identify two inherently distinct entities with each other. And also when dreaming does such an identification of two entities lead to the creation of a composed subject counterpart in the counterfactual world with respect to which the consequent propositions are evaluated (cf. (4)). In order for the dream report in (4) to be uttered felicitously, for example, the subject entity of the second coordinated clause (i.e. she) has to possess properties of both Paula and Angela Merkel, as otherwise Mary could not even have known whom she has identified with each other in her dream.

(4) Mary dreamed that Paula was Angela Merkel and that she had dinner with the Macrons on top of the Eiffel tower.

In order to argue for a novel analysis of counteridenticals along the lines of dream reports and, thereby, strengthen the intuitive parallel that was just established, this paper is structured as follows. In Section 2, we show that counteridenticals and dream reports exhibit striking grammatical as well as perceptual parallels. In Section 3, we then suggest an analysis of counteridenticals along the lines of Percus and Sauerland’s (2003) (henceforward P&S) analysis of dream reports. The proposal incorporates Percus and Sharvit’s (2014) asymmetric be-operator in order to capture the contribution of the identity statement embedded in the counteridentical’s antecedent clause. Section 4 concludes the paper by discussing predictions the proposal makes as well as questions it raises.
2. Parallels Between Counteridenticals and Dream Reports

Counteridenticals and dream reports exhibit at least four parallels with regard to their grammatical and perceptual make-up. Some of these correlations have already been noted by Arregui (2007), but this paper provides two novel arguments in favor of an analysis which treats the two constructions on par.

2.1. Parallel 1—Validity of Identity Statements

Both counteridenticals and dream reports enable us to comprehend clauses which, under canonical circumstances (i.e. excluding role playing situations, etc.), seem irremediably false in extensional contexts. An example of such a clause is given in (5a).

(5)  a. *I was you.
    b. If I was/were you, I would be happier.
    c. I dreamed I was you. (cf. Arregui, 2007: 31)

When evaluated against the facts of the actual world, the identification of two inherently different individuals, here, the referents of I and you, seems clearly infelicitous. Nevertheless, in the case of dream reports (5b) and counteridenticals (5c), we can easily make sense of such a relation, since we derive from their structures that instead of consulting our knowledge of the actual world we are to imagine worlds which differ from ours with regard to some contextually relevant presuppositions, here: the identity of the speaker and the addressee.

2.2. Parallel 2—Principle B Effects

Both counteridenticals and dream reports allow for sequences to occur that cannot be independent matrix clauses.

(6)  a. *I kiss(ed) me.
    b. I dreamed I was Brigitte Bardot and I kissed me.
    c. If we were you, I’d kiss me. (Arregui, 2007: 31)

In extensional contexts (e.g. (6a)) the sequence I kiss(ed) me constitutes a violation of the binding principle B, which requires that a pronoun must be unbound within its binding domain (cf. Chomsky, 1982). In dream reports and counteridenticals, however, pronouns with the same features may have multiple referents, as can be made explicit by adding indices to the examples in (6), yielding (7). Whereas the subscripts i and j are used for pronouns referring to entities inhabiting the actual world in addition to the counterfactual one, the subscript i ⊕ j designates pronouns referring to the non-actual entity that possesses a combination of the antecedent clause’s subject and predicate entity’s properties, i.e. the subject’s dream/counterfactual self. The availability of multiple referents enables the circumvention of the binding principle’s application in (6b)/(6c).
(7) a. *I kissed(ed) me.
b. I dreamed (I was Brigitte Bardot) and I kissed me.
c. If I were you, I’d kiss me.

Strikingly, however, both counteridenticals and dream reports only allow principle B violations for first person pronouns. Similar structures are not permitted for third person pronouns, second person pronouns, or a mix thereof (cf. Arregui, 2007: 32):

(8) a. (i) *If Peter were Bill, he’d kiss him.
(ii) *Sue dreamed [she was Brigitte Bardot] and she kissed her.
b. (i) *If you were me, you’d kiss you.
(ii) *You dreamed [you were Brigitte Bardot], and you kissed you.
c. (i) *If Peter were you, he’d kiss him./you.
(ii) *Peter dreamed [he was you] and he kissed him./you.

This is especially striking since second/third person pronouns may actually have multiple referents, as can be seen from the following example, in which a possessive structure has been chosen to avoid the intervention of the binding principle B (as possessives in English never trigger Principle A/B effects).

(9) If Susan were Sue, she would be in love with her brother.

2.3. Parallel 3—Identity Inferences

In both counteridenticals and dream reports, the counterfactual identification of the subject entity with the predicate entity prompt the assignment of the entire set of (contextually relevant) properties defining the predicate entity to the subject on the part of the listener. If, in such a situation, the speaker wants to change any of the predicate entity’s properties which undergo the re-ascription process, s/he has to make the change explicit. Otherwise the listener is expected to object. Consider, for instance, the following examples:

(10) [CONTEXT. Assuming Angela Merkel does not like traveling.]
 a. If I were Angela Merkel, I’d be traveling all around the world, but (unlike her,) I’d be enjoying it.
 b. A: If I were Angela Merkel, I’d be traveling all around the world and I’d be enjoying it.
    B: Wait a minute, I thought Angela Merkel hates traveling.

(11) [CONTEXT. Assuming you don’t live in a great apartment in New York.]
 a. I dreamed I was you. But you lived in New York and had a great apartment.
 b. A: I dreamed I was you. I lived in New York and I had a great apartment...
    B: I don’t think it was me that you dreamed you were. My apartment is pretty crappy.

(cf. Arregui, 2007: 36)
2.4. Parallel 4—Oneiric Reference Constraint

The pronouns of both constructions obey the Oneiric Reference Constraint (ORC), a syntactic constraint on pronoun movement that rules out any LF for dream reports in which some pronoun referring to the dream-self is asymmetrically c-commanded by a pronoun referring to the actual entity (cf. Percus and Sauerland, 2003: 5). The ORC explains why dream reports involving two pronouns with the same agreement features (e.g. (12)) are ambiguous between only three readings, even though there are four possible combinations of the consequent pronouns’ referents (i.e. the actual-John and his dream-self): It disallows that reading in which the first pronoun refers to the actual self of the dreamer, while the second one refers to that person’s dream-self (26d) (cf. ibid.: 4).

(12) John, dreamed that (he was Peter and that) he was marrying his grand-daughter.
   a. In John’s dream, he\textsubscript{i}⊕j marries his\textsubscript{i}⊕j grand-daughter.
   b. In John’s dream, he\textsubscript{i}⊕j marries his\textsubscript{i} grand-daughter.
   c. In John’s dream, he\textsubscript{i} marries his\textsubscript{i} grand-daughter.
   d. *In John’s dream, he\textsubscript{i} marries the his\textsubscript{i}⊕j grand-daughter.

In counteridenticals, we find a similar pattern (cf. (13)): Those pronouns which can be interpreted ambiguously between referring to the speaker’s actual self and the person s/he counterfactually identifies with obey the ORC. (Note that the first consequent pronoun, I\textsubscript{i}⊕j, is excluded from the constraint in this example since it can never refer back to the actual speaker). In (13), the ORC renders that reading infeasible, or at least marginal, in which the actual speaker’s son shall play with the imagined daughter, i.e. that reading in which the pronoun referring to the counterfactual entity is within the local domain of the pronoun referring to the actual entity.

(13) If we were you, I’d encourage my son to play with my daughter.
   a. If I\textsubscript{i} were you\textsubscript{j}, I\textsubscript{i}⊕j’d encourage my\textsubscript{i}⊕j son to play with my\textsubscript{i}⊕j daughter.
   b. If I\textsubscript{i} were you\textsubscript{j}, I\textsubscript{i}⊕j’d encourage my\textsubscript{i}⊕j son to play with my\textsubscript{j} daughter.
   c. If I\textsubscript{i} were you\textsubscript{j}, I\textsubscript{i}⊕j’d encourage my\textsubscript{i} son to play with my\textsubscript{j} daughter.
   d. *If I\textsubscript{i} were you\textsubscript{j}, I\textsubscript{i}⊕j’d encourage my\textsubscript{i} son to play with my\textsubscript{i}⊕j daughter.

In sum, we have provided at least four striking structural and conceptual parallels between counteridenticals and dream reports. These call for an analysis of counteridenticals on par with that of dream reports, which will be developed in the following section.

3. Analyzing Counteridenticals in Terms of Dream Reports

As with the analysis of any conditional, the overarching question to be answered in this section is what the worlds look like that the antecedent clause of a counteridentical takes us to. The first step to finding an answer to this question is figuring out how the composed counterpart individuals, i.e. those individuals that received an $i⊕j$-index in the above examples, are generated. This query is directly related to the interpretation of the copular clause ‘x be-PAST y’. Once the counterpart individuals are felicitously generated, the analysis then needs to be able to explain the parallels observed between counteridenticals and dream reports.
3.1. The Meaning of ‘If X Were Y’

When analyzing the identity clause embedded in the antecedent of a counteridentical, two empirical observations have to be accounted for. First, the antecedent clause If I were you does not mean the same as If you were me. For this and further reasons, an analysis that interprets both of these clauses by means of the relation $I = you$ is ruled out, which is why this proposal refrains from interpreting the counteridentical antecedent as an equative copular clause (for a more detailed discussion see Kauf (2016)). Secondly, since the copular clause is responsible for generating the composed individual, it needs to be flexible with respect to the (re-)assignment of properties of the predicate entity onto the subject entity’s counterpart. This constraint becomes evident when reconsidering examples (1) and (2), repeated here for convenience as (14) and (15). Whereas the former sentence triggers an ascription of only a partial set of the predicate entity’s properties onto the counterpart (i.e. his/her financial situation in the scenario created above), the latter utterance is true either if the contextually relevant properties connected to being the chancellor of Germany are reassembled or if most/nearly all of Angela Merkel’s properties are transferred onto the counterpart. This dichotomy boils down to the following distinction: Whereas the utterance in (14) is not necessarily true if the composed counterpart is assumed to have all of the contextually relevant properties of the predicate entity—in fact, in such ‘advice’ scenarios, it is usually assumed that the counterpart must have some of the subject entity’s relevant properties (cf. Pelletier, 2004) –, the same configuration always makes utterance like (15) true; the subject entity’s properties are not needed for the true outcome of the consequent proposition.

(14) If I were you, I’d buy the blue dress.

(15) If Paula were Angela Merkel, she’d be the chancellor of Germany.

To give an explanation to both of these observations, the proposal presented in this paper endorses the notion of asymmetric be as proposed by Percus and Sharvit (2014) in its redefinition by Zhang (2016) (indicated below by $\mathit{Zhang} = \equiv$).

Percus and Sharvit receive motivation for the introduction of such an asymmetric be-operator from mistaken identity contexts like the following:

(16) [CONTEXT. Peter is throwing a party in honor of his cousin Dan who has just been awarded his PhD. All the guests know that it is a PhD party, but they don’t all know Dan (and some of them, like Kevin, don’t even know the new PhD’s name). When Becky arrives, Kevin, who is already completely toasted, walks up to her with a big smile. ‘You must be proud to be a doctor now,’ he says. Seeing this, Jim says to Peter:]

a. Kevin thinks that Becky is Dan, (but he doesn’t think that Dan is Becky).

In a nutshell, what the asymmetric copula in (16a) does is take an individual concept as its input and identify it with an individual $x$ (Percus and Sharvit, 2014). If such an individual concept is overtly available, as in Dan is the new PhD student, the concept (here: being the new PhD student) is simply predicated as a property of the subject referent (here: Dan) by means of (17).
For cases as in (16a), in which the copula is used to (mistakenly) identify a person with another individual instead of with an overt individual concept, Percus and Sharvit (2014) suggest a refinement of the semantics of asymmetric be. The predicate entity of the copular clause (here: Dan) is then first coerced into a contextually salient set of properties (here: being the new PhD student) before \( [\text{PRED}]^w \) can be applied to predicate this set of properties of the subject entity (here: Becky) (cf. (18)).

(18) \[
[\text{PRED}]^w_Zhang = [\text{be}_{\text{asymmetric}}]^w_{<s,et>,et>} = \lambda y e. \lambda x e. P(w,y)(w)(x),
\]
where \( P_{(w,y)} \) of type \( <s,et> \) represents the coercion of the individual \( y \) into some contextually salient set of properties in a world \( w \)

Thus, the sentence (16a) comes out to be true if and only if in all of Kevin’s epistemically accessible worlds, Becky’s counterpart possesses Dan’s contextually salient properties; she is the new PhD student.

Turning back to the analysis of counteridenticals, the asymmetric be-operator proves to easily be able to explain the empirical observations stated above. Since the predicate entity is coerced into a set of properties that is subsequently predicated of the subject entity, the asymmetry in meaning between (19a) and (19b) is obtained for free: Whereas in the former clause, it is the addressee that is reduced to a set of properties and a counterpart individual of the speaker living in the counterfactual world is reassigned these properties, in the latter it is reversed. Thus, when uttered in the same situation, the make-up of the counterpart individual in (19a) and (19b) can differ vastly, since the respective contextually salient properties are obtained from different individuals.

(19) a. If I were you \( \rightarrow P_{(w,you)}(w)(I) \)

b. If you were me \( \rightarrow P_{(w,I)}(w)(you) \)

At the same time, the same asymmetry also immediately accounts for the marginality of counteridenticals such as (3), repeated for convenience as (20), in which it is the predicate entity that the counterpart individual is referenced to and not the subject entity.

(20) ?/* If I were Angela Merkel, her name would be Carina.

The marginality originates from the clash that is obtained by the asymmetric be-operator’s wanting to coerce Angela Merkel into a set of contextually relevant properties, here: name properties, and wanting to predicate it of the subject entity, i.e. the speaker, and the proposition expressed by the consequent proposition’s centering around the coerced individual.

What is more, the asymmetric be-operator is also able to explain the second empirical observation, i.e. the different degrees of identification between the antecedent clause’s subject and predicate. It is able to do so as it does not impose any restrictions on the set of properties which the predicate is coerced into. In (21), the speaker assumes the addressee’s external properties
while keeping his/her internal properties intact, a strategy which enables him/her to give advice. Note again that in this case, the consequent property must neither be true of the subject nor the predicate in the actual world (for an example scenario, please refer back to sec. 1, par. 3). By contrast, the truth of the consequent clause in (22) is achieved if Peter is either completely identified with Angela Merkel in the counterfactual worlds or if he is merely identified with her in terms of her contextually relevant properties, i.e. her profession. In this case, the consequent property is always true of the predicate in the actual world. This can be made explicit by adding follow-up phrases to the examples that explicitly negate the truth of the consequent proposition if evaluated with respect to the predicate entity in the real world. Whereas such an extension does not affect the truth value of sentence (21), it turns the counteridentical in (22) false.

(21) If I were you, I’d be buying the blue dress, which you are not buying.
(22) *If Peter were Angela Merkel, he’d be the chancellor of Germany, which she isn’t.

In addition to being able to explain these empirical observations, the asymmetric be-operator is conceptually appealing. Consider for example the sentence in (23):

(23) If Peter weren’t Peter, the situation would have escalated.

When interpreting such sentences, we do not imagine worlds in which Peter is not Peter. Rather, what we infer is that if we were taken to a world in which Peter does not have the contextually relevant set of properties, i.e. being forgiving/calm/funny/etc—but might be just like Peter otherwise—, then the consequent proposition would hold of his counterpart.

All things considered, Percus and Sharvit’s (2014) asymmetric be-operator successfully captures the relation set up between the subject and predicate entity of a counteridentical antecedent clause.

3.2. Explaining the Parallels to Dream Reports

Once the proposal is able to describe the identity relation set up by the counteridentical’s antecedent, it then needs to explain the parallels observed between counteridenticals and dream reports. In this context, it is especially the similarity with respect to the ORC which calls for an analysis of counteridenticals along the lines of Percus and Sauerland (2003).

In their analysis of dream reports, P&S propose to make use of concept generators in their realization as centered worlds; In his/her dream, the dreamer, x, identifies him-/herself with another individual, y, with respect to whom the consequent proposition is evaluated. In other words, P&S assign the predicate dream attitude verb-like semantics:

(24) \[ \text{dream}^x = \lambda P. \lambda x. \lambda w. \text{For all } <y, w'> \text{ in } \text{DREAM}_{x,w}, P(y)(w') = 1. \]

(DREAM\textsubscript{x,w} stands for the set of pairs \(<y, w'>\) such that \(w'\) is a world compatible with \(x\)’s dream in \(w\), and \(y\) is the individual in \(w'\) who \(x\), in \(w\), identifies as himself.)

(ibid: 8)
Multiple pronoun reference in Percus and Sauerland (2003) is accounted for in the following way: Reference to the actual person is realized by means of an unstarrred pronoun (underlined in the following example), which is analyzed in situ like a usual variable. It combines with a world parameter which, due to lambda-abstraction, receives its denotation from the worlds compatible with the agent’s dream worlds, i.e. $w'$. Reference to the dream-self, on the other hand, is realized via a starred pronoun, which behaves similar to a relative pronoun: it does not receive an interpretation in situ but moves to the left periphery of the complement clause, which triggers a predicate abstraction over the trace it leaves behind (cf. Percus and Sauerland, 2003: 7f). Since P&S assume the denotation of ‘dream’ to be similar to that of attitude verbs, i.e. they assume that ‘dream’ quantifies over centered worlds and takes a property (the meaning of the complement clause) as an input (cf. (24)), such a movement leads to an identification of the moved pronoun with the center of worlds that are compatible with agent’s dream worlds, i.e. the dream-self $y$. A possible logical form of a dream report under this proposal looks like the following:

\[(25) \quad \text{[CONTEXT: In his dream, John is Fred]}\]
\[(25) \quad \text{(John) dreamed that he dream-self was marrying his actual-self grand-daughter.}\]
\[(25) \quad \text{a. dream [ he*} \lambda_3 \quad [ \lambda w_1 \quad [\lambda P \quad w_1 \quad t_3 \text{ was marrying [his*} \lambda_2 \quad w_1 \text{] grand-daughter ] ] ]}\]
\[(25) \quad \text{b. } \lambda x. \lambda w. \quad \forall <y,w'> \in \text{DREAM}_x,w, y \text{ marries the grand-daughter of } g(2)(w') \text{ in } w'.\]
\[(25) \quad \text{c. } \text{This "property" will hold, e.g., of John, if he has a dream in which his dream-self,}\]
\[(25) \quad \text{Fred, marries his own, i.e. John’s, grand-daughter.}\]

The ORC now excludes all those structures by means of a concept which P&S call ‘superiority’ in which a starred pronoun $pro^*$ would have to move across an unstarrred pronoun which a) asymmetrically c-commands it and which b) shares the same features $pro^*$ has (cf. Percus and Sauerland, 2003: 13ff) (compare with (12)):

\[(26) \quad \text{John dreamed that he was marrying his grand-daughter.}\]
\[(26) \quad \text{a. In John’s dream, he*} \lambda_3 \quad \text{his*} \lambda_4 \quad [ t_3 \text{ marries } t_4 \text{ grand-daughter.}]\]
\[(26) \quad \text{b. In John’s dream, he*} \lambda_3 \quad [ t_3 \text{ marries his grand-daughter.}]\]
\[(26) \quad \text{c. In John’s dream, [he marries his grand-daughter.]}\]
\[(26) \quad \text{d. *In John’s dream, his*} \lambda_3 \quad \text{[he marries}\quad t_3 \text{ grand-daughter.]}\]

In order to transfer P&S’s analysis to counteridenticals and keep the implications it makes with respect to the ORC intact, some adaptations have to be made. First of all, the starred pronoun responsible for dream-self reference in P&S is dependent on the left periphery of the embedded CP as the landing site for its lambda abstractor, since it needs to be identified with the center of the speaker’s doxastic worlds (cf. (25)). Nevertheless, with counteridenticals no such landing site seems to be available; They do not constitute attitude reports, or otherwise embedded sentences (where the complementizer is part of the embedded CP). One way to remedy this problem is to assume that, even though not visible, there actually is an underlying attitude report-like semantics in the meaning contribution of counteridenticals. Such an assumption receives independent motivation from proposals like Moltmann (2003), who suggests to interpret all propositions as attitudinal objects. For her, it is only in the presence of an illocutionary force
operator that independent sentences receive a ‘complete meaning’ (cf. 97). Under Moltmann’s (2003) proposal, a simple declarative sentence such as (27) is thus interpreted as specifying a property of the speaker (cf. 97).

(27) Mary is happy.
   a. $\lambda x[R_{\text{ass},3}(x,\text{<Happy, T}_1>,\text{<Mary, T}_2>)]$
   b. An agent predicates, in the assertive mode, the property of being happy$_{T_1}$ of Mary$_{T_2}$

(cf. Moltmann, 2003: 98)

In this example, R is an assertion-relation which connects the speaker of the sentence to the proposition that the property of being happy holds of Mary. Hereby, each of the propositional constituents in turn is perceived under a specific mode of presentation, $T_i$ (following the standard literature on propositional attitudes). Whenever the attitudinal component and/or the agent are not specific, Moltmann (2003) suggests to make use of the most basic propositional attitude, that of entertaining, by means of which a way of relating the propositional argument to an agent is always ensured.

Without having to fall back on Moltmann’s default relation of entertaining, we argue that for counteridenticals a relation which contributes an imagine-like meaning constitutes a suitable candidate for the attitudinal relation: If licenses an environment in which the proposition $x = y$ is taken under a relation which has a similar meaning contribution as an imagine-operator (for a further proposal which establishes a relation between if and the presence of imagine cf. Anand (2006), p.c.). The speaker predicates, in an imagine-like-mode, the counteridentical’s consequent property of his/her counterfactual-self (cf. (29)). Without committing ourselves to the existence of an imagine-operator or an exact location to which it applies in the semantics, we suggest the following interpretation of counteridenticals:

As a result of this structure, a (covert) landing site for the starred pronoun needed for an analysis of counteridenticals on par with P&S’s dream reports analysis is created below the operator.

That the presence of if licenses the presence of (a covert) imagine-like-operator can be independently supported, for example by considering conditional sentences like the following. In (28), an imagine-operator occurs overtly, arguably without triggering a change in meaning. Furthermore, the example shows that the antecedent clause of a counteridentical functions as the restrictor of the imagine-worlds, since the consequent clause is not obligatory, but can be pragmatically inferred from knowing which worlds to consider based on the antecedent proposition.
(28) (Imagine) If Julius had been Peter!

Under the made assumptions, counteridentical antecedent clauses thus receive the following, preliminary interpretation:

(29) Preliminary

\[
\begin{align*}
\text{If } x & \text{ were } y \implies \text{imagine } [x \text{ be } y] = \lambda Q. \lambda w. \forall < y, w' > \in \text{IMAGINE}_{x,w}: \\
Q(y)(w') &= 1.
\end{align*}
\]

The denotation of IMAGINE_{x,w} (cf. (29)) is based on that of P&S's DREAM_{x,w}. Nevertheless, given the insights derived from the interpretation of the antecedent clause in the preceding section, the worlds imagined by the speaker are restricted to those which incorporate the additional ingredient of Percus and Sharvit’s (2014) asymmetric be-copula. Hence, the worlds a counteridentical antecedent clause takes us to can, preliminarily, be described as follows:

(30) IMAGINE_{x,w} = \{ < y, w' > | w' is a world compatible with the worlds x imagines in w, and y is the individual in w' from whom x, in w, takes over a contextually relevant set of properties (meaning that } P_{(w,y)}(w')(x) = 1, where P_{(w,y)} of type <s,et> represents the coercion of the individual y into a contextually salient set of properties in w)\}.

(based on P&S 2003; Percus&Sharvit 2014)

With these semantics in place, multiple pronoun reference in the counteridentical’s consequent clause can be accounted for as in Percus and Sauerland (2003) (cf.(25)), leading to the following analysis of (31).

(31) (If I were you,) I imagine self’d love me actual self.

a. (I) imagine [I* \lambda 3 [\lambda w_1 [\lambda p \lambda w_1 t_3 \text{love } \text{me}_2 w_1 ] ] ]

b. \lambda x. \lambda w. \forall < y, w' > \in \text{IMAGINE}_{x,w}: y \text{loves } g(2)(w') \text{ in } w'.

c. This property will hold, e.g., of the speaker, if for all of his/her imagined world, at which s/he takes over contextually relevant properties from the addressee, his/her imagined self loves his/her actual self. (cf. ibid: 8)

Reference to the actual speaker is achieved through \textit{in situ}-interpretation of the first person pronouns (cf. me_2 in (31)). By contrast, reference to the dream-self, i.e. the addressee, is realized via a starred pronoun (cf. I* in (31)) which moves to the left periphery of the complement clause, thereby triggering a predicate abstraction over the trace it leaves behind. Since IMAGINE_{x,w} is assumed to quantify over centered worlds and takes the meaning of the complement clause as an input, the starred pronoun gets associated with the counterpart individual, y (cf. (29)). The ORC effects then follow parallel to those in dream reports.

Even though the proposal as it stands provides answers to several crucial questions in the analysis of counteridenticals, it has (at least) two shortcomings. First, unlike in P&S’s analysis of dream reports, in the current analysis of counteridenticals, the antecedent’s predicate entity, y, should not be the same as the consequent y (as we’re proposing that the predicate entity is only an individual that the subject entity takes over properties from, but not one s/he completely identifies with). This challenge also becomes evident when considering that the asymmetric
be-operator actually wants to quantify over ‘subject entity-centered’ worlds and not ‘predicate entity’-centered worlds, as it currently does (cf. If I were you \( \rightarrow P_{w,you}(w)(I) \), where I is the individual that constitutes the counterpart individual at the counterfactual world, albeit with properties of the addressee, whereas the addressee is the individual that is merely coerced into a set of properties). Secondly, the proposed analysis so far can only account for counteridenticals in which the person setting up the counterfactual scenario is the same as the subject entity of the counteridentical’s antecedent clause, as in (31). Nevertheless, a theory of counteridentical meaning should be able to also account for sentences like If Peter were Susan, he would VP and If you were me, you would VP, where a speaker is imagining worlds in which another person is counterfactually identified with a third person/the speaker.

In order to solve the first challenge, we tentatively propose that the antecedent and consequent y’s in (29) are in fact not the same. Instead, a new variable, \( z \), is introduced which references the counterpart individual—the individual of whom the consequent proposition holds. In the new analysis, \( z \) and not \( y \) constitutes the center of the IMAGINE-worlds \( x \) sets up. The counterpart individual \( z \) is able to receive the relevant combination of properties from the antecedent clause’s subject and predicate entities in the following way: On the one hand, it provides the second argument of the asymmetric be-function, which is thus assigned the set of properties the predicate entity \( y \) is coerced into. On the other hand, it is associated with, and thereby receives the missing properties from, the subject entity \( x \) by postulating that the presupposition \( z \simeq_{w'} x \) is part of the meaning contribution of imagine.

Independent evidence for the introduction of another entity variable, \( z \), for the counterpart individual can be obtained by considering counteridenticals like (32), in which reference to all three individuals, the antecedent’s subject and predicate entity, and their shared counterpart individual is made.

(32) If I were you, I'd be sitting where you are and I'd be looking at me.

Under this proposal, we receive the following analysis of the sentence If I were you, I'd kiss me:

(33) If I were you, I imagined-self’d kiss me actual-self.

a. \( [ [ (I) imagine [ I be you ] ] [ I' \lambda_3 [ \lambda_1 w_1 [ VP w_1 t_3 kiss [ me_2 w_1 ] ] ] ] ] \)
b. \( [ \lambda y. \lambda x. \lambda w. \forall \zeta < z, w' > in \{ IMAGINE_{w',w} \land P_{w,y}(w') (z) : z \simeq_{w'} x \} \rightarrow z \) kisses g(2)(w') in w'(you)(I)
c. True iff for all of the speaker’s imagined worlds at which his/her imagined self takes over a set of contextually relevant properties from the addressee, his/her imagined self kisses his/her actual self.

To account for the second challenge, i.e. counteridenticals in which the speaker is imagining worlds in which not s/he but another person is identified with a third person, we tentatively suggest to detach the center of the imagined worlds from the imaginer him-/herself. Via a counteridentical’s antecedent, a speaker attitudinally relates him-/herself to a counteridentical proposition centering around a person \( a \), i.e. s/he imagines an entity \( a \) to have a property, based on which s/he draws a consequence in the consequent clause about the ‘altered \( a \)’. Whereas
the speaker is the default imaginer of a counteridentical, a may or may not be the speaker him-/herself or a different person (cf. (34)). Since the embedded clause of this ‘attitude report’ (here: the counteridentical) only attaches below this matrix clause, the lambda abstractor responsible for the interpretation of the starred pronoun, yielding the counterfactual counterpart of a according to the dream-report proposals, can receive its information from a and is not dependent on the speaker. Phrased differently and everything put together, we thus propose counteridentical antecedents to have semantics along the following lines:

(34) Final Version
a. \[\text{If } a \text{ were } y]^{s} = \text{imagine}_{sp(c)} [a be y]^{s} = \lambda Q. \lambda a. \lambda y. \lambda w. \forall < z, w' > \in \{ \text{IMAGINE}_{(sp(c),w),a} \land P_{(w,y)}(w')(z) : z \simeq_{w'} a \} \rightarrow Q(z)(w') = 1, \]
whereby sp(c) = speaker, and
b. IMAGINE_{(sp(c),w),a} = \{ < z, w' > | w' is a world compatible with the worlds sp(c) imagines in w, and z is the individual in w' which sp(c), in w, identifies with \}
and P_{(w,y)}(w')(z), meaning that z possesses y's contextually salient properties. \[2\]

The fact that the presupposition relation \(\simeq_{w'}\) always relates the counterpart individual to the subject entity and not the speaker can be independently supported via applying well-known presupposition projection tests, like the subsequent, in which the relevant presupposition \(a \simeq_{w'} z\) projects across the board:

With the semantics in (34), a sentence like (35) then receives the following interpretation:

(35) SCENARIO. Susan, in real life, has a brother, but Sue does not have one.
If Susan were Sue, she imagined-self’d be in love with her actual-self brother.

a. imagine_{sp(c)} (Susan [she* \lambda 3 [\lambda w_1 [\lambda t_3 be in love with [her_2 w_1] brother ]]])

b. [\lambda w. \forall < z, w' > in \{ IMAGINE_{(sp(c),w),Susan} \land P_{(w,y)}(w')(z) : z \simeq_{w'} a \} \rightarrow z kisses g(2)(w') in w' ]

c. True iff for all of the speaker’s imagined worlds at which Susan’s counterpart self takes over a set of contextually relevant properties from Sue, this counterpart self of Susan is in love with Susan’s actual brother.

One further tentative argument in favor of an analysis which incorporates two differently centered worlds—i.e. a world centered around the speaker and one centered around the subject entity’s counterpart—is that it predicts the duality of deixis observed in counteridenticals: Whereas some indexicals seem to always be anchored to the speaker (cf. (36)), others seem to be relative to either the subject entity or the counterfactual counterpart (cf. (37)). Note that in the examples, the relevant deictic center has been made explicit by means of subscripts. Interestingly, the observed deictic relations persist regardless of the entities identified with each other by means of the antecedent clause.

\[2\] Note that when a speaker is reporting a counteridentical another person is attitudinally related to (e.g. Susan thinks that if Peter were John, he VP), the value of the imaginer in the semantics change accordingly. The report’s speaker then is attitudinally related to predicating a counteridentical attitude to the attitude holder, here Susan, likely via an assertion or entertaining relation (cf. Moltmann, 2003).
3.3. Interim Conclusion

Under the proposed analysis, the striking parallels between counteridenticals and dream reports laid out in Section 2 receive a proper explanation. The fact that identity statements like I was you can be felicitously used in counteridenticals and dream reports (Section 2.1) can be explained via the proposal’s implementation of Percus and Sharvit’s (2014) asymmetric be-operator which induces the creation of a counterpart of the subject entity at the counterfactual worlds without assuming proper identification. The parallel in identity inferences (Section 2.2), follows directly from the similar assumptions of composed individuals and how the composition comes about (also cf. Section 1 for a discussion). The Oneiric Reference Constraint (Section 2.3) follows directly by suggesting counteridentical LFs to be along the lines of P&S’s dream report analysis. Finally, the similarities with respect to the Principle B effects follow from assuming a difference between the real individuals and their shared counterpart.

4. Implications and Open Questions

After having laid out how the analysis works in detail, this section sets out to discuss further predictions the proposal makes and questions it raises.

Let us first reconsider the asymmetric be-operator discussed in section 3.1. One of the reasons we adopted the operator for our analysis was its flexibility with respect to the amount of properties it coerces the predicate entity into before predicating them of the subject entity to create a suitable counterpart individual at the counterfactual worlds. Given this flexibility, the proposal predicts counteridentical antecedent clauses to have a variety of meanings, ranging from limited, partial contextually relevant property reassignment to complete (contextually relevant) identification. Counteridenticals in which the composed counterpart only takes over a partial set of contextually relevant properties from the predicate entity will henceforth be referred to as ‘advice’ counteridenticals. Counteridenticals which demand complete, at least contextually relevant, identification are dubbed ‘imagine’ counteridenticals. In this context, it is crucial that

Note that by means of adding focus one can easily shift between the two types of counteridenticals. To prove this point, consider the following scenario. In the first clause the speaker makes use of an ‘advice’ counteridentical whereas the second clause consists of an ‘imagine’ counteridentical:

(i) SCENARIO. You are afraid of heights whereas I love the thrill. You were invited to go sky-diving and are asking me what to do and I say . . .

a. If I were you, I’d totally go, it sounds like so much fun . . . but, then again, if I were you, I probably wouldn’t go, I don’t think you’d be able to enjoy it.

Even though the antecedent clause remains the same in both conditionals and the consequent clauses oppose each other, we understand the utterance. Given the different foci, the clauses do not pose a contradiction to each other.

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the term ‘advice’ counteridenticals is solely dependent on the partial reascription of properties from one individual to another and not on usual pragmatic assumptions about advice giving, i.e. it is usually uttered in a speaker-addressee context and given about the future. As a result, both of the following sentences count as ‘advice’ counteridenticals for the purposes of this paper:

(38) ‘Advice’ counteridenticals
   a. If I were you, I’d buy the blue dress. (I like it much better than the green one.)
   b. If I were Stephen Hawking, I would’ve insisted on a speaking device with a British accent. (It surprises me that he didn’t.)

For the same reason, counteridentical antecedents within the usual setting of advice giving (as described above) can receive an ‘imagine’ interpretation:

(39) ‘Imagine’ counteridenticals
   a. If Paula were Angela Merkel, she’d be the chancellor of Germany.
   b. (I’m so jealous of you right now.) If I were you, I would already be done with all of my papers and could enjoy the weather. (Instead, I am stuck at my desk.)

A naïve empirical test which strengthens the intuition that there is a difference in meaning between ‘imagine’ and an ‘advice’ counteridenticals is to replace the antecedent clauses by ‘in {predicate entity}’s shoes’—forcing an advice-reading—and checking the acceptability of the resulting clause for the intended meaning. From the sample comparison in (40) we see that the test results in a degraded judgment for the ‘imagine’ counteridentical whereas the ‘advice’ counteridentical’s meaning remains unchanged.

(40) a. In your shoes, I’d buy the blue dress.
   b. *In your shoes, I would already be done with all of my papers.

Across languages, both the ‘advice’ and the ‘imagine’ readings can be found, as predicted. Also across languages, we usually find constructions like In s.o.’s shoes, which can felicitously replace the copular antecedent clause in ‘advice’ counteridenticals but not ‘imagine’ counteridenticals. Interestingly, however, in many languages, the availability of such constructions does not block the copular clause-antecedent for ‘advice’ counteridenticals, rendering the ‘advice’ and the ‘imagine’ readings vastly unspecified (e.g. in English, German, French, Dutch).

Nevertheless, other languages do disambiguate between these readings. One strategy hereby consists of having different, designated antecedent clauses for the two kinds of counteridenticals which stand in complementary distribution to each other, thus enabling a blocking of the other reading. This is for example the case for Polish, Greek or LIBRAS (for an in-depth discussion, see Kauf, 2016). In Polish, the construction usually used to express counteridenticals, i.e. past tense-marking of the copula in combination with the subjunctive mood (Gdybym był toba [= literally: I be-PAST you]), is restricted to the ‘imagine’ reading of counteridenticals, even though the copula is not generally restricted to equative contexts. In the case of ‘advice’ counteridentical, by contrast, speakers of Polish must make use of a paraphrase structure (Na Twoim miejscu [= literally: On your spot]) (p.c. Z. Fuchs; Kauf (2016)).
In other languages it is the grammatical tense of the consequent clause which helps to distinguish between the two readings: According to Han (1996), counterfactuality in Korean arises via a conversational implicature that is drawn when a conditional sentence uses past-tense morphology in its antecedent and future-tense morphology in its consequent (cf. ibid.: 5). Extending Han’s morphological discussion, the following four grammatical structures have been approved for Korean present counterfactuals by Ahn and judged with respect to their validity for the two uses of counteridentical antecedents (p.c.):

1. [...V-Past...if] [...V-Fut] ['Advice’ ✓/‘Imagine’ ✓]
2. [...V-Past...if] [...V-Past-Fut] ['Advice’ ✓/‘Imagine’ ✓]
3. [...V-Past...if] [...V-Past] ['Advice’ ✓/‘Imagine’ ✓]
4. [...V-Past...if] [...V-Pres] ['Advice’ ✓/‘Imagine’ *]

(Han 1996, extended by Ahn (p.c.))

What is notable about this data for the purpose of this paper is that the use of the PRES-IND in the consequent forces an ‘advice’ reading, while all other structures can be used ambiguously between the two suggested interpretations. To illustrate this distinction more clearly, consider the following set of example sentences, provided by Ahn (p.c.), where ‘Advice’-readings presuppose a context in which the speaker proclaims what he would do if he were in Mary’s situation—he would go into the sea, even though she might not —, and the ‘Imagine’-counteridentical version could, for example, be uttered in a scenario in which the speaker has just received a message with a picture showing Mary going into the sea at this moment and is now fantasizing about being her.

(41) If I were Mary, I would go into the sea right now.
   a. Nay-ka Mary-i-ess-tamyen, cikum-ccum pata-ey teleka-l.kess-ita. [A/I] I-NOM Mary-be-PAST-if around.now ocean-DAT enter-FUT-IND ‘If I were Mary, I would go in the sea right now.’
   b. Nay-ka Mary-i-ess-tamyon, cikum-ccum pata-ey teleka-ss-ul.kess.ita. [A/I] I-NOM Mary-be-PAST-if around.now ocean-DAT enter-PAST-FUT-IND ‘If I were Mary, I would go in the sea right now.’
   c. Nay-ka Mary-i-ess-tamyon, cikum-ccum pata-ey teleka-ss-ta. [A/I] I-NOM Mary-be-PAST-if around.now ocean-DAT enter-PAST-IND ‘If I were Mary, I would go in the sea right now.’
   d. Nay-ka Mary-i-ess-tamyon, cikum-ccum pata-ey teleka-n-ta. [A/*I] I-NOM Mary-be-PAST-if around.now ocean-DAT enter-PRES-IND ‘If I were Mary, I would go in the sea right now.’

The proposal thus correctly predicts the antecedent clause of counteridenticals to have different meanings in addition to being able to explain the parallels between counteridenticals and dream reports. In these respects it fares better than existing analyses of counteridentical meaning like Kocurek (2016) and Lakoff (1996) (for a detailed discussion, see Kauf (2016)). At the same time, however, it raises several questions.

For reasons of clarity and comprehensibility, this analysis has been limited to Korean present counterfactuals. For an in-depth analysis of Korean past counterfactuals, the reader is encouraged to consult Han (1996).
A first question which should be answered as part of future research is why the principle B violations persist in the case that $a \neq y$ (Section 2.1), i.e. whenever we are talking about 2nd/3rd person pronouns. One potential answer consists in assuming a speaker special hypothesis to be at work. Following this line of argumentation, Arregui (2007), suggests that first person pronouns allow for special binding, namely *de se* binding (cf. 38). A tentative answer in line with the analysis proposed in this paper is that only for first person pronouns it is the case that the center of the dream worlds is associated with the speaker, i.e. the default imaginer. For all other values of $a$, the imaginer and the center of the imagine worlds are distinct. Finding answers to this question might also help to shed further light on the integration of the analyses of counteridenticals and dream reports, since reports like *I dreamed that Peter was John and that he married his brother* seem parallel to counteridenticals with second and third person subjects, but have not been included in Percus and Sauerland’s (2003) theory.

Another, more pressing, question concerns the proposal’s compatibility with existing analyses of counterfactual meaning. In the beginning of this paper it was stated that counteridenticals are first and foremost counterfactuals; hence, standard analyses of counterfactuals (e.g. Iatridou (2000) and Ippolito (2013)) should be applicable to counteridenticals as well. Interestingly, however, these analyses are not trivially able to capture the correct meaning of counteridenticals (for a more detailed discussion see Kauf (2016)). Under past-as-past analyses like Ippolito (2013) it is in particular the assumption of a historical accessibility relation that is not philosophically trivial. In stipulating such a relation, we would have to assume—everything else remaining the same—that there is a point in time in the past such that some kind of ghost develops into one person in one set of continuations of those worlds while developing into another person in another set of continuations. It seems doubtful, however, that such a point in time should exist. An alternative was recently presented by Krifka (2018), who also interprets the past morphology in the counterfactuals as a real past, but proposes it to quantify over commitment spaces rather than worlds; hence, the philosophical concerns do not necessarily arise. Under past-as-fake proposals like Iatridou (2000), the main difficulty concerning the analysis of counteridenticals arises from the definition of the closest worlds. Whereas it is true for ‘imagine’ counteridenticals that in all those closest worlds in which the antecedent clause holds, i.e. in which the subject entity is identified with the predicate entity, the counterpart entity does whatever the predicate entity does, the same conditionality relation is inherently rejected for ‘advice’ counteridenticals; these contrary-to-fact worlds are twice removed from the actual world: The subject entity is not the same as the predicate entity, and his/her counterpart does not necessarily do what the predicate entity would do in the consequent situation (cf. sec.1 par 3 for an example situation). Hence, some other factors must be at play.

A question which immediately arises for the current proposal in this context is whether the $\forall$-quantifier in the denotation of *imagine* requires a similarity relation. Of course, we can imagine all kinds of worlds; nevertheless, underlying the semantic representation of counteridenticals is the constraint to stay as close to the real world as possible when imagining worlds at which the antecedent proposition holds. A further prediction this proposal thus makes is that every (counterfactual) conditional licenses a covert, center-inducing *imagine*-like operator. The investigation of these and further questions, like the proposal’s interaction with focus or aspect, is left to future research.
References

Abstract. This paper argues that Double Access sentences in English (Smith, 1978) are a kind of loose talk. When the meaning of a Double Access sentence is computed literally, the result is infelicity. Double Access sentences can be used meaningfully only when rescued by pragmatics which intervenes to interpret the embedded clause loosely. A formal model for loose interpretation, building on Klecha (2018), is provided.

Keywords: tense, embedding, Double Access, imprecision, defaults, embedded implicature.

This paper argues that Double Access sentences in English are a kind of loose talk. Double Access sentences (Smith, 1978) are typified in English by featuring a Present-Tensed clause embedded under a Past-Tensed attitude verb (henceforth I refer to this morphosyntactic configuration as Present-under-Past).

(1) Dorothy said that Tricia is sick.

Double Access sentences are often characterized as giving rise to two inferences; a simultaneous inference and a speech time inference. The supposed simultaneous time and speech time inferences of (1) are given in (2) and (3) respectively.

(2) The Simultaneous Inference of (1)
(1) CONVEYS: According to D’s speech event S, T is sick at \( \tau(S) \).

(3) The Speech Time Inference of (1) (Classical Analysis)
(1) CONVEYS: T is sick at \( \tau(1) \)

This second inference, however, is not a consistent consequence of (2). Characterizing the speech time time inference of Double Access sentences remains difficult.

I present a characterization of the second inference, and then present a formalized analysis of Double Access as a case of non-literal meaning, one which also critically requires that non-literal meaning to be calculated at a local level. Specifically, I argue that Double Access sentences are, in a sense, grammatically ill-formed, and require pragmatic intervention to be rescued. It is as a consequence of this pragmatic rescue that the second inference arises.

The paper proceeds as follows. In Section 1, I present the essential facts surrounding Double Access, and provide some theoretical context for their significance. In Section 2, I present and motivate the temporal semantic framework I adopt. In Section 3, I present and motivate the pragmatic framework I adopt. In Section 4, I briefly lay out my assumptions regarding Double Access.
embedded implicature. In Section 5, I bring these elements together to present the analysis, before concluding.

1. Double Access

Here I present what I take to be the critical facts surrounding Double Access.

1.1. Fact #0: Present-under-Past Morphology

First of all, Double Access sentences have a curious morphological pattern: Present-under-Past morphology. While this is not a semantic fact, it is worth noting. This is because the analysis of embedded tense (at least in English) is tied up with the morphosyntax of tense. Many analyses of English embedded tense posit a syntactic Sequence of Tense (SOT) rule (e.g., Ladusaw, 1977; Kratzer, 1998; Schlenker, 2004; Stowell, 2007; Klecha, 2016) which says that certain other sentences of English are not what they appear on the surface.

In particular, an SOT rule is usually invoked to explain the two putative readings of (4).

\[(4)\] Dorothy said that Tricia was sick.

\[(5)\]  
\[\text{Simultaneous Reading of (4)}\]
\[\text{a. (4) CONVEYS: According to D’s speech event } S, T \text{ is sick at } \tau(S).\]
\[\text{b. (4) CONVEYS: According to D’s speech event } S, T \text{ is sick prior to } \tau(S).\]

\[(6)\]  
\[\text{Backshifted Reading of (4)}\]
\[\text{a. (4) CONVEYS: According to D’s speech event } S, T \text{ is sick at } \tau(S).\]
\[\text{b. (4) CONVEYS: According to D’s speech event } S, T \text{ is sick prior to } \tau(S).\]

According to the SOT rule analysis, the Backshifted Reading is the result of embedding a real Past Tense under another one. Tenses are (or can be) interpreted relatively, meaning that the evaluation time of the embedded Past Tense is the reference time of the matrix one; thus Dorothy’s speech event is in the past relative to (4), but Tricia’s alleged sickness is further in the past with respect to Dorothy’s speech event.

The Simultaneous Reading, however, is the result of embedding a fake Past Tense under a real one. Details vary, but what these analyses generally have in common is that “fake Past Tense” is not a lexical item, but a derived one. For example, Ladusaw (1977) posits that an underlying Present Tense undergoes agreement, so that it becomes morphologically past; Klecha (2016) presents further arguments for this. Kratzer (1998), on the other hand, posits an underlying Null Tense which undergoes agreement. Stowell (2007) argues against a transformational account, instead arguing that Fake Past results from a different combination of lexical items than Real Past.

\[^{2}\text{Altshuler and Schwarzschild (2013) argue that the simultaneous reading entails the backshifted reading.}\]
What these analyses all have in common, however, is that Present-under-Past morphology can never be realized on the surface under normal circumstances. The Present-Tense-Agreement approach of Ladusaw and Klecha predicts that Present Tense will always be morphologically realized as Past Tense when it is embedded under Past Tense. The Null-Tense-Agreement approach of Kratzer stipulates that Present Tense (and tenses generally) cannot be embedded under an attitude verb for type reasons, while Stowell’s account makes Present Tense singularly unembeddable under Past Tense by way of a syntactic polarity mechanism.

Naturally, the mere existence of Present-under-Past morphology is, on its face, problematic for all these accounts. Stowell’s account is specifically designed with Double Access in mind, and posits covert movement which rescues Present-under-Past morphology from the polarity violation, but results in the unusual interpretation.

An alternative, of course, is to pursue approaches that simply don’t make use of a syntactic SOT mechanism. Some, like Abusch’s (1997) semantic feature transmission approach, or Ogi-hara’s (1995) highly influential tense deletion approach, are essentially semantic analogs of the syntactic SOT approach, and operate on the same logic—allowing the embedded past in Past-under-Past cases to be interpreted as something other than a simple anterior operator. Because these are not syntactic in nature, they don’t problematize Present-under-Past morphology. Others, like Gennari (2003); Altshuler and Schwarzschild (2013), simply reject the ambiguity of Past-under-Past cases altogether, treating them instead as cases of generality, and requiring no SOT mechanism whatsoever.

However, these analyses have difficulty providing a non-stipulative answer to the highly marked semantics of Double Access, whereas syntactic SOT approaches can motivate the marked semantics by way of the marked syntax. Next, I explore said marked semantics.

1.2. Fact #1: The Simultaneous Inference

As discussed before, Double Access sentences give rise two inferences, one of which has proven difficult to characterize. The easy one, however, is the simultaneous inference, repeated below.

(1) Dorothy said that Tricia is sick.

(7) The Simultaneous Inference of (1)

(1) CONVEYS: According to D’s speech event S, T is sick at \( \tau(S) \).

While easy to characterize, this inference is not always easy to account for. As discussed above, there is an ongoing debate in the embedded tense literature about what kind of SOT rule, if any, is necessary for a proper analysis of the English facts. This debate is also tied up in another controversy, over whether tenses are indexical or relative.

What is uncontroversial is that in unembedded contexts, tenses behave as if they are indexical.
Thus the tense in each of (8a-b) relates event time (ET; the time of the event described by the verb) to speech time (ST; time of the speech event).

(8) a. Tricia is sick. \hspace{1cm} ET = ST
b. Tricia was sick. \hspace{1cm} ET < ST

What is also uncontroversial is that in certain embedded contexts, (certain) tenses behave as if they are relative; i.e., their evaluation time is not ST, but rather another time determined by their syntactic environment. In (9), the Past Tense on *turned* conveys that the turning-in event is in the past with respect to the giving-an-A event, which is in turn in the future with respect to ST. So the turning-in time need not be in the past with respect to ST.

(9) Alan will give an A to every student who turned in their homework.

The question is which of these behaviors is exceptional. The relative approach says that (9) is the norm, and (8) is due to a default rule for evaluation time determination; whereas the indexical view says that (8) is the norm, and (9) is due to indexical shifting.

This debate is most consequential for the analysis of embedded cases, especially Past-under-Past and Present-under-Past. On the relative view, the backshifted reading of Past-under-Past is readily accounted for, while the simultaneous reading is not—which is what necessitates appeal to SOT rules. The indexical view, on the other hand, predicts no ambiguity, but rather generality between simultaneous and backshifted cases, so one potential advantage to the indexical view is that it could avoid having to posit SOT rules. (The problem for the indexical view is that this generality should extend to a forward-shifted case, which does not usually exist. More on this below.)

As for Present-under-Past, the relative view predicts that it should simply have a simultaneous reading and nothing else (to the extent that Present-under-Past morphology can be squared with SOT). So the simultaneous inference is a strong point for the relative view. The indexical view, on other hand, has no means to predict a simultaneous inference, which makes this inference highly problematic for such views, unless they are considered cases of indexical shifting–but if indexical shifting is available here, it ought to be available in Past-under-Past cases as well, in which case the indexical theory starts to be indistinguishable from the relative one.

What is problematic for the relative theory, however, is that the simultaneous inference isn’t the only inference that Double Access sentences give rise to.

1.3. Fact #2: The Speech Time Inference

When Double Access sentences were first discussed by Smith (1978), she characterized the second inference they give rise to as being (10).

(1) Dorothy said that Tricia is sick.
The Speech Time Inference of (1) (Classical Analysis)

However, Ogihara (1995) showed that this is not the correct characterization; (9) can be uttered, felicitously and truthfully, in cases like (11).

(11)  
   a. Tricia’s nose is running and her face is puffy.
   b. Jamie knows she has allergies, but Dorothy doesn’t.
   c. D/E: Tricia is sick.
   d. A bit later, Jamie runs into Emily.
   e. J/E: Tricia has allergies.
   f. E/I: Oh, Dorothy said that she’s sick.
   g. E/I: Guess she’s wrong.

Furthermore, Double Access sentences do not convey that the embedded event hold at ST in the worlds of the attitude (i.e., (11f) does not convey that Tricia being sick at ST is an entailment of what Dorothy said), nor do they convey that the embedded event hold at ST in the ST-belief worlds of the attitude holder (i.e., (11f) does not convey that Dorothy currently believes Tricia to be sick at ST); see Ogihara (1995) for detailed arguments.

My characterization of the Speech Time inference is as follows: It is the inference that anyone who believes the content of the attitude believes that the prejacent holds at ST. Thus it is odd for the speaker of a Double Access sentence who endorses the content of described attitude to deny that the prejacent holds at ST.

(12)  
   a. Dorothy concluded that Tricia is sick.
   b. And Dorothy is always right about this kind of thing.
   c. So Tricia certainly was sick...
   d. #...but she probably isn’t anymore.

This can be shown even more clearly with a factive attitude, which requires the speaker to endorse the content of the attitude.

(13)  
   a. Dorothy realized that Tricia is sick.
   b. #...but she isn’t anymore.

This pattern does not depend on the subject being the endorser.

(14)  
   a. Dorothy said Tricia is sick.
   b. And she stands by what she said.
   c. #But she thinks Tricia isn’t sick anymore.

Moreover, as discussed by Schlenker (2004), there is a limit on the span between reference time and UT; but also it depends on the embedded predicate. See also Bary et al. (this volume) for more discussion.
(15)  
   a.  \{Yesterday/\text{?Last month/#2 years ago}\}, John said that Mary is pregnant.
   b.  \{A minute ago/#Yesterday\}, Mary said that John is in the kitchen.
   c.  The ancient Romans thought that the sun revolves around the earth.

This fact follows from my characterization of the speech time inference.

It is this inference which is troublesome for any analysis of embedded tense. On their face, indexical analyses seem best suited to handle this problem, since a naïve indexical analysis predicts that Present-under-Past should give rise to a speech time inference. However, such an analysis does not predict the inference exactly as I characterized it; it instead predicts the second inference possibility that Ogihara showed to be wrong (i.e., that the prejacent holds at ST in the worlds of the attitude).

What’s more, most if not all non-naïve indexical analyses posit the existence of an Upper Limit Constraint (ULC). Originating with Abusch (1997), the ULC is a stipulated filter on permissible LFs that bans any LF which lets an embedded reference time be later than the time of embedding attitude verb. In other words, it simply rules out the forward-shifted cases discussed in the previous section that the indexical analysis would otherwise predict. It is the Upper Limit Constraint, on indexical analyses, which rules out (16), whereas on relative analysis, it is ruled out by the semantics of Past Tense.

(16)  #Three days ago Dorothy said that Tricia was sick yesterday.

The ULC further problematizes any attempt to account for Double Access, because it ought to violate it. So there is no obvious mechanism which would derive these facts. I argue that this fact does follow from general mechanisms, but they are pragmatic mechanisms—imprecision and default inferences—which I discuss in Section 3.

1.4. Fact #3: Interaction with Aktionsart

Finally, in many (but not all) contexts, stative attitude verbs are incompatible with Double Access (Altshuler et al., 2015). This is another fact in need of explanation.

(17)  I saw John yesterday.
   a.  He said that Mary is pregnant.
   b.  #He thought that Mary is pregnant.

1.5. Interim Summary

Although I have presented a characterization of the Speech Time inference, I have not explained how it arises, why it arises together with the Simultaneous inference, nor why this configuration favors eventive predicates. In brief, my analysis is that (18) can be felicitously uttered at \( t \) if the difference between \( t \) and the time of Dorothy’s saying is, for the purposes of discussing Tricia’s
(alleged) sickness, irrelevant; we can thus conflate the two and treat Dorothy’s saying time as identical to $t$, allowing use of Present Tense but giving rise to a Simultaneous Inference. But without this conflation there is a violation of the Upper Limit Constraint, so (17) can only be felicitously used when conflating the two times, thus the Speech Time Inference.

2. The Temporal Semantics

2.1. Attitude Verbs

I mostly adopt the temporal semantics framework of Klecha (2016). Klecha observes that the Upper Limit Constraint, discussed above, is lexically variable. Thus, some attitude verbs, like hope, do allow for forward-shifted readings; (18a) requires that Tricia’s sickness be prior to Dorothy’s thinking, but (18b) does not.

(18) a. Dorothy thought Tricia got sick.
   b. Dorothy hoped Tricia got sick.

An important upshot of this observation is that the Upper Limit Constraint does exist, and needs to be reconciled with Double Access.

I adopt Klecha’s analysis of attitude verbs, which accounts for these facts. On Klecha’s analysis, attitude verbs (and modals generally) quantify not over worlds but over histories, which can be modeled as world-interval pairs.

(19) \[ \text{Histories} \]
    \[ \text{if } h = \langle w, t \rangle, \, \omega(h) = w \text{ and } \tau(h) = t \]

Maximal histories are those who interval component is the maximal temporal interval, representing the whole timeline of a given world. But modals can also quantify over partial histories, and thus restrict the range of possible temporal reference in their prejacents. Particularly, attitude verbs like say and think (and most other finite-embedding ones) quantify over actual histories, whose time component is an interval $(-\infty, t]$ for some $t$; i.e., the interval representing the past and present of $t$, but not its future. This is what prevents forward-shifting in the case of these attitudes.

(20) \[ \text{Actual Histories} \]
    \[ \mathcal{A}_t := \{ h \mid \tau(h) = (-\infty, t] \} \]

So the denotation for think is (21a), where $\text{DOX}_{x,t,h}$ is the set of histories consistent with $x$’s beliefs in $h$ at $t$, and the denotation for say is in (21b), where $\text{DC}_{x,t,h}$ is the set of histories consistent with the discourse commitments induced by $x$’s utterance in $h$ at $t$.

\[ \text{This ignores the eventive component of say, since there is no representation of an actual saying event, only the stative/modal component. A better denotation would include this, but I exclude it because modeling this component is not relevant for the present investigation.} \]
(21) a. \[[\text{think}]^c_s = \lambda p \lambda x \lambda t \lambda h[\forall i \in A \cap \text{DOX}_{x,t,h}[p(i)]]\]
b. \[[\text{say}]^c_s = \lambda p \lambda x \lambda t \lambda h[\forall i \in A \cap \text{DC}_{x,t,h}[p(i)]]\]

(21) says that \text{think} combines with a prejacent proposition (a property of histories; denoted by the embedded clause), individual (the subject), a time, and a history, and is true iff, in every actual history consistent with the beliefs of the subject at the evaluation time in the evaluation history, \(p\) is true.

2.2. Indexical Tenses

Klecha also argues for an SOT rule and a relative semantics for tenses. But his analysis of the ULC alone does not demand a relative semantics for tense, and in fact makes an indexical analysis possible, at least without considering other data. I will not weigh in on this question, except to point out that indexical readings of embedded tenses must at least be possible. This is shown by the behavior of the Past Perfect under Past.

First, consider that the Past Perfect requires the existence of a salient past time.

(22) Andy walks into Chuck’s party and sees Bella.
   a. A/B: Why so serious?
   b. B/A: Chuck (#had) kissed my ex.

(22b), which is discourse initial, is bad when put into a Past Perfect configuration, but good in the simple Past. Presumably the requirement is a uniform property of the Past Tense; it always requires its reference time to be salient. But in cases of the Simple Past, the time of the event is identified with reference time, and so it can be accommodated to act as the salient past time. In the case of the Past Perfect, however, the event time must be in the past with respect to Past’s reference time, so this is what requires a genuinely salient past time from prior discourse apart from the event time.

However, when embedded under a Past Tense attitude, this requirement seems to go away.

(23) Andy walks into Chuck’s party and sees Bella.
   a. A/B: Why do you look grim?
   b. B/A: Chuck told me a few weeks ago that he (had) kissed my ex the day before.

This can only be because the salient past time needed by the Past Tense is the time of the matrix attitude verb, tell. But this would require that the reference time of the embedded Past Tense is simultaneous with, not prior to, the time of the attitude. The only way for purely relative past theories to account for this is to posit SOT. But this cannot be a case of SOT either—that would mean that (23b) is a case of the Present Perfect which has undergone SOT; but the Present Perfect is incompatible with frame adverbs like \text{the day before} (see e.g., Portner, 2011).

So either tenses are indexical, or, if they are relative, there is a mechanism which allows the
possibility of indexical readings, while perhaps also allowing relative readings. This mechanism could be Stowell’s movement operation, which would make the seemingly embedded relative tense unembedded, and thus behave as if indexical. But for the sake of simplicity and space, I will simply adopt an indexical analysis of tense for the purposes of this discussion. So the denotation I assume for the tenses are as follows, where 0 is the distinguished variable that all assignments map to ST; thus \( g_c(0) \) below represents ST.

(24) a. \( [\text{PST}_j]_s^c = \lambda p \lambda h[p(g_c(j))(h) \& g_c(j) < g_c(0)] \)
   b. \( [\text{PRS}_0]_s^c = g_c(0) \)

2.3. The Upper Limit

A typical verb phrase is modeled as in (26), where \( h|t \) is defined in (25).

(25) a. \( h|t \) is defined iff \( \tau(h) \cap t \) is a non-empty interval
   b. if defined, \( h|t := \langle \omega(h), \tau(h) \cap t \rangle \)

(26) \( [\text{Tricia be sick}]_s^c = \lambda t \lambda h[\exists s[\text{sick}(s)(\omega(h)) \& \tau(s) = \tau(h|t)]] \)

Combining such a verb phrase with tense, and then an attitude, gives (27) and ultimately (28).

(27) \( [\text{Tricia PST}_j \text{ was sick}]_s^c = \lambda h[\exists s[\text{sick}(s)(\omega(h)) \& \tau(s) = \tau(h|g_c(j))] \& g_c(j) < g_c(0)] \)

(28) \( \forall i \in A_{g_c(k)} \cap DC_{d,g_c(k),h} \exists s[\text{sick}(s)(\omega(i)) \& \tau(s) = \tau(i|g_c(j))] \& g_c(j) < g_c(0)] \)

(28) models the meaning of (29).

(29) Dorothy said Tricia was sick.

Notice that if \( g_c(j) \), the salient time picked out by Past Tense, is later than \( g_c(k) \), the evaluation time of think, and thus outside the interval component of (all values of) \( i \), the result will be a crash, because the term \( i|g_c(j) \) will be undefined. This is what enforces the Upper Limit Constraint. Thus (28) correctly predicts that (29) is consistent with backshifted or simultaneous cases, but not forwardshifted ones.

Accordingly, replacing Past Tense in the embedded clause with Present Tense guarantees infelicity, according to the present model, since \( g_c(0) \) is now necessarily later than \( g_c(k) \).

(30) \( [\text{PST}_k \text{ Dorothy say Tricia PRS}_0 \text{ is sick}]_s^c = \lambda h[g_c(k) < g_c(0)] \& \forall i \in A_{g_c(k)} \cap DC_{d,g_c(k),h} \exists s[\text{sick}(s)(\omega(i)) \& \tau(s) = \tau(i|g_c(0))] \]

This is a feature of the analysis, not a bug: I argue that the literal meaning of Double Access sentences is ill-formed. I argue that Double Access sentences are only uttered meaningfully
because they are rescued by pragmatics. I now present the tools necessary to formalize this.

3. Pragmatics

Two features of pragmatic interpretation will play important roles here. First, *imprecision* is what allows humans to utter sentences whose literal meaning is false, but whose *pragmatic meaning* may be true. In other words, imprecision is a phenomenon by which sentences are mapped to meanings which are weaker than their literal semantics.

\[(31)\]
\[
a. \text{ Julian arrived at 3.} \\
\text{b. (31a) CONVEYS: J arrived at around 3.}
\]

Second, *default reasoning* is one of several pragmatic features which allow humans to utter sentences whose literal meaning is true, but whose pragmatic meaning is false; i.e., it is a feature which allows sentences to be strengthened relative to their literal meaning, in this case with information that is considered an ordinary, but not necessary, consequence of the literal meaning of the expression.

\[(32)\]
\[
a. \text{ I opened the door.} \\
\text{b. (32a) CONVEYS: I opened the door using the doorknob.}
\]

Below I present a formal framework for pragmatic interpretation, before explaining how imprecision and defaults are captured within it.

3.1. The Framework

Following many authors on formal pragmatics (e.g., Franke, 2009; Jäger, 2012), I assume that literal meaning is relevant to interpretation only in as far as it serves as a baseline from which to determine what is actually communicated, analogous to the underlying representations of phonology. So for every sentence, there is a literal meaning determined by semantic meaning conventions (and perhaps also the semantic context \(\sigma_c\)), and then a pragmatic meaning, which is a function of that and of the pragmatic context \(\rho_c\). The pragmatic meaning of a sentence could be enriched by scalar implicature, for instance.

\[(33)\]
\[
\text{SEMANTIC MEANING: } [S]_s^c \quad \text{PRAGMATIC MEANING: } [S]_p^c
\]

The pragmatic context specifies things like alternative utterances which compete with the target utterance (crucial in the case of scalar implicatures for example), but also a set of *domain goals* and *prevailing assumptions*. 
3.2. Imprecision

Per Klecha (2018), imprecision is determined by the domain goals. The domain goals for a given discourse are the issues, choices, or questions, which are considered by the interlocutors to be worthy of their attention. The domain goals can be modeled as a partition $K$ on the logical space. Each cell in the partition contains worlds which are indistinguishable for the purposes of the domain goals. So, if it is in my domain goals that I catch my train at 3, then perhaps a cell in the partition which models it will contain both a world where I leave at 2:59 and a world where I leave at 3:00, because the question of leaving at 2:59 versus 3:00 is doesn’t matter for the purposes of catching my train; either way, I’ll make it in time. But if leaving at 3:05 would result in my missing the train, worlds where I do so will end up in a different cell.

One effect of pragmatic interpretation is that meanings are coarsened. In other words, they are pixelated according to the resolution imposed on the logical space by the domain goals. Consider a proposition $p$ against the backdrop of the logical space $W$.

![Figure 1: W (maximum resolution)](image1)

![Figure 2: Wρ](image2)

So in a context where imprecision is the only pragmatic effect on meaning, the pragmatic meaning of a sentence $S$ will be as in (34).

$$\llbracket S \rrbracket^c_p = K_{\rho(W)}(\llbracket S \rrbracket^c)$$

3.3. Defaults

Default inference is a related phenomenon (e.g., Jäger, 2012; Franke, 2014; Klecha, 2018). Here I assume that the pragmatic context has another parameter, prevailing assumptions, which are responsible for default inferences. Prevailing assumptions are simply propositions which both interlocutors either assume to be true, or act as if are true because they believe the other interlocutor to be assuming them. Prevailing assumptions narrow the logical space, making assertions more informative than they might otherwise be. I’ll use $P_\rho$ to stand for the prevailing
assumptions in a given context $c$.

For any sentence uttered in a context where default inferences and imprecision are the only pragmatic effect on meaning, the pragmatic meaning of a sentence $S$ will be as in (35).

\[(35) \quad [S]_{p}^{c} = K_{P_{c}}(P_{c})([S]_{p}^{c})\]

3.4. Accommodation

The domain goals and prevailing assumptions are both discourse parameters. They can, at least in some cases, be modified by a process similar to accommodation, a la Lewis (1979). As discussed by Klecha (2018), for example, utterance of a non-round number in a context that otherwise makes such a number equivalent to a round number causes the standard of precision to rise; i.e., it causes the domain goals to become richer, and thus the logical space becomes more finely partitioned. As Klecha argues, since non-round numbers are more costly to utter, one should have no reason to utter them when imprecision makes nearby round numbers indistinguishable. Once they are uttered, the hearer has no choice but to recognize that the speaker must be assuming a higher standard of precision. Accommodation of prevailing assumptions is crucial to the present analysis, as discussed below.

4. Embedded Implicature

Lasersohn’s (1999) analysis of imprecision says that each lexical item in a derivation is assigned an imprecise interpretation, and then those are composed alongside the literal meanings, thus determining a pragmatic interpretation for the sentence as a whole. Klecha (2014, 2018) argues against this; since different expressions within a sentence might be interpreted with different levels of precision.

\[(36) \quad \text{For the dinner tonight we need 50 place settings and 200 bottles of beer.}\]

According to Lasersohn (1999), individual terms like 50 and 200 would need to be assigned standards of precision before composing with other elements in the sentence. But since (36) provides a sentence where, conceivably, 50 could be interpreted with maximum precision, and 200 with less than maximum precision, it can’t be that precision is determined at the lexical item level, with no input from the rest of the sentential context. So Klecha argues for an entirely post-semantic pragmatic interpretation mechanism.

The present analysis of Double Access says that the literal interpretation of a Double Access sentence is ill-formed, and needs to be rescued by pragmatics. But this pragmatic rescue cannot happen entirely after semantic composition. If it did, the input to pragmatic interpretation would be an infelicitous sentence with no meaning.\(^4\) Instead, the embedded clause must be assigned a pragmatic interpretation before composing with the attitude verb, to avoid violation of the Upper Limit Constraint.

\(^4\)Thanks to Julian Grove (p.c.) for making this point especially clear to me.
The notion that pragmatics may occur below the sentence level is not a new one. Besides Lasersohn (1999), it has been recently argued that certain implicatures can be calculated in the midst of composition. For example, Potts et al. (2015) argues that embedded implicatures are derived in a manner not so dissimilar from Lasersohn, with pragmatic alternatives being assigned to every lexical item, composing pointwise, resulting in a set of alternative interpretations for the whole sentence. The optimal alternative is then selected and becomes the pragmatic interpretation for the sentence.

However, to avoid the problem with imprecision raised by Klecha (2014, 2018), I propose that alternatives be assigned to every clause (i.e., proposition denoting projection) rather than every lexical item. This allows for an analysis of (36) whereby the difference between 50 place settings and 51 matters, but the difference between 200 bottles of beer and 201 doesn’t. It also still allows for Potts et al.’s (2015) treatment of embedded scalar implicatures.

5. Analysis

Recall the literal meaning of Double Access sentences is undefined, thanks to the term \(i|g_c(0)\).

\[
\begin{align*}
\text{[PST}_k \text{ Dorothy say Tricia } & \text{PRS}_0 \text{ is sick}]^c_i = \lambda h[g_c(k) < g_c(0) & \\forall i \in a_{g_c(k)} \cap \text{DC}_{d,g_c(k),h} \exists s[\text{sick}(s)(& \omega(\omega)) & \text{& } \tau(s) = \tau(i|g_c(0))]])
\end{align*}
\]

But Double Access is acceptable at sufficiently low temporal resolution, where we can (due to pragmatic enrichment) conflate ST and the past ET of the attitude verb, so that the Upper Limit Constraint is not violated. The fact that this low-resolution construal is necessary to rescue (1) explains its various interesting behaviors.

5.1. Step One: Temporal Resolution

Being at temporal resolution \(d\) (for the purposes of discussing Tricia’s sickness) means we i) partition the temporal space into intervals of length \(d\), and ii) ignore the possibility that Tricia’s sickness state will change within any of the cells. This is modeled as a prevailing assumption; the discourse participants assume that if Tricia is sick at one moment within any of the partition-intervals, she is sick at all moments within said interval. This is the sense in which ST and the past ET of the attitude verb are conflated.

5.2. Step Two: Imprecision

Klecha’s (2018) theory of imprecision assumes that any discourse’s domain goals will provide a partition on the logical space, where that logical space is composed of worlds. But having enriched the logical space so that it is made up of histories, rather than worlds, per Klecha (2016), how does the partition work? For the most part, the same–histories are world-interval pairs, so partitioning can mostly continue by partitioning histories according to their world-components.
But what about histories who share a world component, but have different temporal components? Are they ever sorted into different partitions by the domain goals? I assume that a principle applies in these cases.

First, let us say that history $h$ branches from actual history $i$ if their world components are identical up to the endpoint of $\tau(i)$ and $\tau(i)$ ends prior to the end of $\tau(h)$.

$$i \sqsubseteq h := \omega(i) \approx_{RB(\tau(i))} \omega(h) \; \& \; RB(\tau(i)) < RB(\tau(h))$$

In other words if $h$ branches from $i$, then $h$ is a continuation of $i$. Consider now a principle for determining whether branches ought to be lumped by a given partition or not.

(39) 
Principle of Temporal Imprecision

a. If all $k \in P_\rho$ such that $i \sqsubseteq k$ and $t \in \tau(k)$ answer $p(t)$? the same
b. and $i \sqsubseteq h$ and $t \in \tau(h)$
c. $h$ and $i$ will not be distinguished by $p(t)$? in $P_\rho$

So in other words, if $h$ is a branch of $i$, and $p(t)(h)$ is true, but $p(t)(i)$ is undefined because $i$ does not extend far enough into the future to include $t$, then $i$ will not be considered to answer $p(t)$? the same as $h$, unless it’s also true that all live branches of $i$ that do extend up to $t$ answer the question the same way, where live means “in $P_\rho$”, i.e., consistent with the prevailing assumptions of $\rho$.

5.3. Accounting for Double Access

So generally a history which extends only up to the past time of Dorothy’s thinking will not be lumped in with one that extends up to ST. But if a prevailing assumption has been adopted that imposes a temporal resolution on the discourse that conflates Dorothy’s thinking time with ST, such histories can be lumped together.

Thus, at such a context, the pragmatic interpretation of the embedded clause (40a) will contain (as usual) a bunch of histories extending up to speech time at which Tricia is sick at speech time ($h_{5-8}$ in Fig. 3); but it will also include histories which do not extend up to speech time, so long as they extend at least as far the left boundary of the cell $t_d$ in the temporal resolution which also contains speech time, and so long as Tricia is sick during the portion of $t_d$ which is included in the history ($h_{9-13}$ in Fig. 3). Since that now means that it contains worlds that are actual histories of Dorothy’s saying time $t_{say}$ ($h_{12}, h_{13}$ in Fig. 3), (40a) can be embedded under say, where say’s evaluation time is $t_{say}$, without incurring a violation of the ULC.

(40) 
Semantic and pragmatic values for Tricia is sick given model in Fig. 3

a. Tricia is sick.
b. $[(40a)]_s^t = \{h_2, h_3, h_4, h_5, h_6, h_7, h_8\}$
c. $P_\rho \cap [(40a)]_s^t = \{h_5, h_6, h_7, h_8\}$
d. $K_\rho(P_\rho)([(40a)]_s^t) = \{h_5, h_6, h_7, h_8, h_9, h_{10}, h_{11}, h_{12}, h_{13}\}$
Figure 3: Pragmatic interpretation of (40a)

The inference modeled by (40d) is the Simultaneous Inference—because in all the histories that are actual histories of \( t_{\text{say}} \), Tricia is sick at \( t_{\text{say}} \).

(41) a. \[ \llbracket \text{Tricia is sick} \rrbracket^c = K_{\rho}(P_{\rho})(\llbracket \text{Tricia is sick} \rrbracket) \]
   b. \[ \llbracket \text{PST}_{k} \text{ say } \llbracket \text{Tricia is sick} \rrbracket^c \rrbracket = \lambda x \lambda h[g_c(k) < g_c(0) & \forall i \in \mathcal{X}_{R_c(k)} \cap \mathcal{D}_{c,g_c(k)}, h[i \in \llbracket \text{Tricia is sick} \rrbracket] \]

So the pragmatic enrichment obviates the ULC, and derives the Simultaneous Inference.

And what about the Speech Time inference? It is not properly a part of the meaning of the sentence itself, pragmatic or otherwise. But recall that Double Access sentences can only be interpreted if the context is one with an appropriate temporal resolution. If the context does not already have that resolution, it must be accommodated. Accommodating that resolution gives rise to the Speech Time Inference—it amounts to accommodating the presupposition that Tricia is either sick or well throughout the duration of each interval of the temporal partition.

This accounts for why a speaker who commits herself to believing the content of the attitude must also believe that the prejacent eventuality still holds at speech time. In order to utter the Double Access sentence in the first place, the speaker commits to a temporal resolution whereby the eventuality’s runtime must include all or none of the interval spanning both the time of the attitude and speech time, in any world.

It also explains the time limit facts, since one would only adopt such a temporal resolution if they believed that the state of affairs in question was unlikely to change in the timespan of the relevant interval. And it goes further, in fact, predicting that sometimes the time limit would be shorter than others simply based on what temporal distinctions are relevant. For example, it generally predicts that while (42) is bad, (43) is good, as has been noted previously.
(42) #John told me Ted is pregnant a year ago.

(43) a. A: Ted hasn’t been drinking lately because he’s pregnant.
    b. B: Whoa, wait, how is it you know that he’s pregnant?
    c. A: {A minute ago/Yesterday,} John told me he is.

This is because pregnancies generally remain stable from minute to minute or day to day, but not year to year. Thus a temporal resolution on the order of minutes or days is generally acceptable, but on the order of years is not.

However, the present theory also predicts that the temporal resolution can be even smaller than what the embedded predicate requires, and thus the embedded predicate provides only an upper bound on the time span for Double Access sentences. (44) bears this prediction out.

(44) a. A: Ted hasn’t given birth yet; but he will sometime in the next few hours.
    b. B: Whoa, wait, how is it you know that Ted’s pregnant?
    c. A: {A minute ago/#Yesterday}, John told me he is.

(44a) establishes a temporal resolution no coarser than a few hours, since (44a) makes an important distinction between the present moment, when Ted has not given birth, and a time a few hours from now when is expected to have done so. The yesterday-variant of (44c) is therefore bad, since it requires a temporal resolution broad enough to conflate ST with the previous day.

5.4. Preference for Eventives

The last thing to explain is the fact that eventive attitudes are much more common in Double Access sentences than stative ones (Altshuler et al., 2015). This can be explained in light of the assumption that there is a preference for the Present Tense over the Past Tense; Altshuler and Schwarzschild (2013) argue that the Present Tense is more informative than the Past Tense. It could also be that the Present Tense is inherently more relevant, in the sense that, all things being equal, information about the present is more likely to bear on the domain goals of any given discourse than information about the past. Or it could be that the Present Tense is simply less marked than the Past. In any case, this assumption is important to the logic of the present analysis of Double Access–pragmatic enrichment allows for the use of the Present-under-Past construction, but it for the most part gives rise to the same inference that Past-under-Past would. So there must be a reason for speakers to want to use Present-under-Past in the first place.

So, if our temporal resolution is coarse enough to conflate ST and ET, and thus use Present Tense in the embedded clause instead of Past, why then should it be that we don’t also use Present Tense on the attitude verb? Since past and present are conflated, shouldn’t everything be in Present Tense? Yes, and that’s why Double Access is often bad with stative attitude verbs:

(45) a. #John thought Ted is pregnant.
    b. John thinks Ted is pregnant.
The reason this doesn’t carry over to eventive attitudes, is that episodic present tense with
eventive verbs is impossible (Bennett and Partee, 1978).

(46) a. John discovered that Ted is pregnant.
    b. #John discovers that Ted is pregnant.

Following Bennett and Partee (1978), I assume this is for type-reasons–ST is a moment, and
the runtimes of events must be non-singleton intervals. Thus when an eventive VP composes
with Present Tense, the result is a crash.

(47) \[[\text{PRS}_0 \text{Tricia get sick}]^e = \lambda h[\exists e[\text{getsick}(e)(\omega(h)) \land \tau(e) \subseteq \tau(h|\text{gc}(0))] = \lambda h[#]]

Lastly, a crucial point: The present proposal allows for the pragmatic enrichment of certain
constituents as a way to rescue what might otherwise be a compositional crash. This could
lead to the concern that pragmatic enrichment creates an escape hatch for type-clashes or pre-
supposition failures–depriving semantic theory of its ability to predict infelicity of certain lex-
ical combinations for semantic reasons. But this example illustrates why that concern would
be misplaced–this particular clash cannot be remedied by pragmatic enrichment, because it
happens below the clause level. And pragmatic enrichment generally can only rescue com-
positional mishaps that would otherwise happen at clause boundaries–this is because of the
amendment to the Lasersohn (1999)/Potts et al. (2015) apparatus for pragmatic enrichment
whereby enrichment only occurs to clause-typed constituents.

6. Conclusion

This paper presents a proposal by which Double Access is a special kind of loose talk. In
particular, Double Access sentences can be felicitously used when the temporal resolution in the
discourse is sufficiently coarse so as to conflate the event time of the attitude verb with speech
time; in other words, in discourses where the interlocutors don’t care to make the distinction
between event and speech time for the purposes of discussing what they’re discussing. This
can be accounted for by simply allowing for the application of certain well-known pragmatic
enrichments–imprecision and default inferences–to embedded clauses.

For reasons of space, no discussion of prior analyses of Double Access is presented, in particu-
lar, the dominant de re theory (Ogihara, 1995; Abusch, 1997). See Gennari (2003) for critique
of these approaches. The biggest advantage of the present theory is that it keeps the semantic
theory of tense quite simple. Some outstanding questions do still need to be answered, espe-
ially how the present theory bears on debates over relative and indexical treatments of tense.

References

1–50.
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Abstract. Schwager (2011) and Sudo (2014) argued that there are cases of the so-called third readings of attitude reports, initially discovered by Fodor (1970), that cannot be accounted for in terms of a theory of indexed world variables (Percus, 2000), which is often referred to as the Standard Solution. More complicated alternatives to the Standard Solution have been recently formulated in the literature in a number of papers. We argue that all the seemingly problematic cases can be naturally accounted for in terms of the Standard Solution, if we take into account the existence of previously unrecognized elided material in these reports.

Keywords: attitude reports, non-specific transparent, hard cases, Standard Solution.

1. Introduction

In this paper, we discuss so-called third readings of indefinites in attitude reports, originally discovered by Fodor (1970). Third readings exist in addition to the familiar de re and de dicto readings and combine some properties of both. The theory that is known in the literature as the Standard Solution straightforwardly accounts for third readings by introducing a mechanism of indexed world variables into the syntax. The hard cases for the Standard Solution are the challenging examples that were proposed by and discussed in Schwager (2011) and Sudo (2014). These authors argued that the hard cases called for more complicated alternatives to the Standard Solution.

Alternative theories have been formulated in terms of evaluating a property in the metaphysically closest worlds where the property is not empty (Schwager, 2011), substitution of contextually equivalent functions (Sudo, 2014), generalized concept generators (Baron, 2015), and a pragmatic account that assumes a modification of the context set of the conversation (Tiskin, 2016).

We will argue that all the seemingly problematic cases can be naturally accounted for in terms of the Standard Solution. We make an observation that in all of the problematic belief-reports the structure is more complex than was previously assumed. In a number of cases, there is elided material that needs to be reconstructed. We show how reconstructing this material allows the Standard Solution to deal with the problematic cases. We thus intend to show that more complicated treatments are not required to account for third readings.

The discussion in this paper will proceed as follows. In Section 2, we briefly introduce third readings. In Section 3, we discuss the Standard Solution and how it captures these readings. Section 4 presents two illustrative challenging cases from Schwager (2011). In Section 5, we demonstrate how those cases can be naturally accounted for in terms of the Standard Solution.

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given some independently motivated assumptions. In Section 6, we go over other known hard cases and show that our proposal can be successfully extended to those cases as well.

2. Third readings of attitude reports

Third readings of attitude reports are known to be a middle case between the more familiar \textit{de re} and \textit{de dicto} readings. Third readings combine some properties of a \textit{de re} and some properties of a \textit{de dicto} interpretation but cannot be reduced to either. Consider a simple example in (1).

(1) Mary wants to buy an expensive dress.

According to a \textit{de re} interpretation of (1), there is a particular expensive dress and Mary wants to buy that dress. Mary is specific about the object that she wants to buy, but it is from the speaker’s perspective that the object is an expensive dress. Mary might not be aware of its price or even that it is a dress. She might describe this object to herself differently.

The \textit{de re} interpretation can be expressed in terms of an indefinite taking scope over the intensional verb (the idea goes back to (Russell, 1905). At LF, the indefinite \textit{an expensive dress} undergoes quantifier raising as illustrated in (2) in the notation of Heim and Kratzer (1998).

(2) [ [an expensive dress] [1 [ Mary [ wants [PRO to buy t₁]]]]]

Interpreting the indefinite in this position has two major effects on the interpretation of (1). The existential quantifier introduced by the indefinite scopes above the universal quantifier introduced by the attitude verb. This makes the \textit{de re} reading of (1) \textit{specific} (Mary wants to buy a concrete object). The descriptive content of the indefinite is evaluated in the actual world (and not in the worlds compatible with Mary’s desires). This makes the \textit{de re} reading \textit{transparent} (the object that Mary wants to buy is an expensive dress from the speaker’s perspective). \textit{De re} readings of attitude reports are, thus, also known as \textit{specific transparent}.

According to a \textit{de dicto} interpretation, Mary wants to buy some expensive dress but she does not have a specific dress in mind.

Under the scope theory, this reading is expressed by interpreting the indefinite below the attitude verb (allowing it to raise only locally to avoid a type mismatch), as illustrated in (3):

(3) [Mary [ wants [ [an expensive dress] [1 [PRO to buy t₁]]]]]

The \textit{de dicto} reading is known as \textit{non-specific opaque} (because the indefinite scopes below the attitude verb and its descriptive content is interpreted in Mary’s desire alternatives).

This sentence also has a third reading that is \textit{non-specific transparent}: Mary does not have a concrete dress in mind and is choosing among what happens to be expensive dresses from the point of view of the speaker (but not necessarily in Mary’s desire alternatives). The third reading thus shares the transparency of a \textit{de re} interpretation (the objects that Mary is
choosing from are judged as expensive dresses from the speaker’s perspective) and the *non-specificity* of a *de dicto* interpretation (Mary does not want any particular dress).

Expressing this reading in terms of the scope theory is challenging and requires additional assumptions (see (Keshet, 2008; 2011)).

3. The Standard Solution

The third reading of the attitude report in (1) can be successfully modeled within a theory that is now known as the Standard Solution (Percus, 2000).

The two key ingredients of this theory are indexed world variables and lambda abstractors that bind those variables in the syntax at each clausal level. In this system, each predicate including the ones that are inside DPs comes with its own word variable. The world variable that a predicate inside a DP carries does not have to have the same index as the main predicate of the clause and therefore can be bound by a different lambda abstractor. The LFs of sentences containing propositional attitudes, like the one in (1), have two lambda abstractors: the matrix one and the embedded one.

A possible LF for (1) is given in (4) and the resulting interpretation of this LF is given in (5).

\[
(4) \text{ LF: } [\lambda w_1 \text{Mary wants}-w_1 [\lambda w_2 [\text{an [expensive dress}-w_1]]] [1 \text{ PRO to buy}-w_2 t_1]]
\]

\[
(5) \ | |(2)||^#(w) = 1 \text{ iff } \\
\forall w' \in \text{Desire-Alt(Mary,w)}: \exists x (x \text{ is expensive dress in } w \& \text{ Mary buys } x \text{ in } w')
\]

What we observe in (4) is that the DP “an expensive dress” stays within the embedded clause. The world variable that comes with the predicate “expensive dress” carries an index that is different from the index of the world variable on the main verb of the embedded clause and is bound by the matrix lambda abstractor. Thus, the existential quantifier is interpreted in the scope of the intensional verb, which accounts for the fact that Mary is not specific in her desire, but the predicate “expensive dress” is interpreted with respect to the actual world and not in Mary’s doxastic alternatives, which accounts for the fact that she does not know that those dresses are expensive.

4. Two counterexamples to the Standard theory (Schwager, 2011)

In this section, we will discuss two illustrative examples from Schwager (2011).

4.1. Malte’s jacket

One seemingly problematic example discussed by Schwager (2011) is given in (6).

\[
(6) \text{ Adrian wants to buy a jacket like Malte’s.}
\]
The context that makes this example problematic is as follows.

*Context:* Malte has a green Bench jacket. The attitude holder, Adrian, also wants a green Bench jacket but he does not know what kind of jacket Malte has.

Native speakers of English report that (6) is acceptable in this context.

The reading that (6) has in the context given above is a third reading: Adrian is not specific and what he wants to buy is described from the point of view of the speaker.

If third readings are generated by evaluating an embedded predicate with respect to the actual world, then the challenge here is that it is not clear what predicate we could evaluate with respect to the actual world to capture this judgment.

Since Adrian does not know what kind of jacket Malte has, evaluating “jacket like Malte’s” with respect to Adrian’s doxastic alternatives does not give us the right interpretation. However, as (Schwager, 2011) points out, evaluating this predicate with respect to the actual word does not help us either. In order to see this, let us consider the LF in (7), where the world variable on the predicate “jacket like Malte’s” is bound by the matrix lambda abstractor.

\[(7) \ [\lambda w_1 \text{Adrian wants-}w_1 [\lambda w_2 \text{PRO to buy-}w_2 a \text{[jacket like Malte’s-}w_1 \text{]} ] ] \]

Interpreting this LF results in the truth-conditions given in (8).

\[(8) \ ||(7)||^g(w) = 1 \text{ iff } \forall w'\in \text{Desire-Alt(Adrian,w)}: \exists x(x \text{ is a jacket like Malte’s in } w \& \text{ Adrian buys } x \text{ in } w')\]

The problem that Schwager notices here is that (8) predicts that, in his desire alternatives, Adrian has to choose from the actual green Bench jackets (under the reasonable assumption that “like” stands for “being of the same type and color”). This does not seem to be right. Since colors are not essential properties of objects, a jacket can have one color in one world and a different color in another world. The truth conditions in (8) predict that Adrian in his doxastic alternatives will buy a red Bench jacket as long as it is a green Bench jacket in the actual world. Thus, in the case of example (8), the Standard Solution seems to overgenerate. On the other hand, intuitively, if some jacket happens to be a green Bench jacket in one of Adrian’s bouletic alternatives but is a red Bench jacket in the actual world, Adrian should be able to buy this jacket in that alternative world. This, however, is not captured by the truth-conditions in (8). According to (8), Adrian, in his bouletic alternatives, has to be buying one of those jackets that happen to be green Bench jackets in the actual world. Thus, the Standard Solution seems to undergenerate as well as overgenerate at the same time.

We can conclude that the predicted interpretation of the LF given in (7) does not reflect the fact that the sentence in (6) is intuitively true in the given context.
4.2 Burj Khalifa

Another difficult case discussed by Schwager is presented by the example in (9).

(9) Mary wants to buy a building with 192 floors.

The context that brings to light the problem with (9) is as follows.

Context: Mary is looking at Burj Khalifa, the building in Dubai that has 191 floors. No other currently existing building has more floors that that number. However, Mary does not know this. She also does not know how many floors Burj Khalifa has. She says, ‘Wow, I want to buy a building that’s even one floor higher!’

According to Schwager (2011), there are two possible LFs that the Standard Solution can give to this sentence. In the one given in (10), the DP “building with 192 floors” comes with the world variable that is bound by the embedded lambda abstractor. Schwager rejects this LF because Mary does not know the height of the building. The other option is the LF given in (11), where the world variable on the predicate “building with 192 floors” is bound by the matrix lambda abstractor. This ensures that the predicate is evaluated transparently (with respect to the actual world).

(10) $\lambda w_1$ Mary wants-w$_1$ $[\lambda w_2$ PRO to buy-w$_2$ a [building with 192 floors-w$_2$ ] ]

(11) $\lambda w_1$ Mary wants-w$_1$ $[\lambda w_2$ PRO to buy-w$_2$ a [building with 192 floors-w$_1$ ] ]

The problem with the LF in (11) is that the predicate “building with 192 floors” has an empty set as its extension in the actual world (because no such building exists in the actual world). This LF will get the interpretation shown in (12).

(12) $\|\!(11)\!\|_w = 1$ iff $\forall w' \in$ Desire-Alt(Mary,w):

$\exists x (x \text{ a building with 192 floors in w } \& \text{ Mary buys x in w'})$

Since there are no worlds where the existential claim holds true, the entire sentence is true only if the set of Mary’s desire-alternatives is empty. (This is due to the properties of the universal quantifier that is involved in the interpretation of the intensional verb “want” that yields true if its restrictor is empty).

4.3 Schwager’s (2011) proposal

Schwager (2011) argues that the challenging cases discussed above require us to abandon the Standard Solution. She suggests that the problematic cases can be accounted for if we adopt the Replacement Principle in (13).

(13) Replacement Principle: For the sake of reporting an attitude, a property that is involved in the content of the attitude that is to be reported (the reported property) can be
replaced by a different property (the reporting property) as long as the reported property is a subset of the reporting property at all relevant worlds.

An important part of this proposal is the notion of a relevant world. Schwager (2011) suggests that the relevant worlds are those which are closest to the actual world and in which the reporting property is not empty.

This principle accounts for the Malte’s jacket example because in every relevant world (i.e. the closest worlds in which there are jackets like Malte’s—green Bench jackets—and Malte has the same jacket as he does in the actual world) the reported property (being a green Bench jacket), is a subset of the reporting property (being a jacket like Malte’s).

The Burj Khalifa example is accounted for in a similar way. Even though the property of being a building that is one floor higher than Burj Khalifa is empty in the actual world, we are looking only at those worlds where there are 192-floor buildings and Burj Khalifa has 191 floors as it does in the actual world. So, in each of her bouletic alternatives, Mary ends up buying one of the 192-floor buildings from the closest worlds and the fact that the predicate 192-floor building is empty in the actual world is no longer relevant.

Even though Schwager’s analysis correctly captures the problematic cases, it may raise questions regarding its independent motivation. Invoking the notion of closest worlds only for the purposes of evaluating a predicate seems to be a technical tool that gives us the correct truth conditions but has no other relevant use. It is not also clear why appealing to these worlds gives us the right truth conditions. Deriving those readings from mechanisms that are more familiar and better understood would be preferable.

5. Analysis

In what follows, we argue that all the hard cases can be accounted for in terms of the Standard Solution. We employ one general strategy. In each case, we observe that the relevant attitude report contains an elided predicate or is equivalent to a report that is directly picked up from the context and contains an elided predicate. We reconstruct the predicate, allow it to be evaluated in the actual world in the spirit of Percus (2000), and derive the third reading.

5.1. Predicting the Malte’s jacket example

We follow Schwager (2011) and assume that being a jacket like Malte’s means being a jacket of the same brand and color. This suggests that we are dealing with an equative construction (Heim, 2000; Bhatt and Pancheva, 2004) that, like other comparative constructions, assumes comparative deletion (Bresnan, 1973; Lechner, 2014). For the purposes of this demonstration, we do not commit ourselves to any particular syntax associated with a like-comparative. We only require that there be some kind of NP-ellipsis (or N′-ellipsis (Jackendoff, 1971)) in the relevant attitude report, as suggested in (14):

\[ \text{But see (Matushansky and Ruys, 2007) for a discussion of the semantics of same, which is similar to the construction considered here.} \]
Adrian wants to buy a jacket like Malte’s jacket.

We assume that the elided NP, like all other NPs, comes with a world variable that can be bound by a matrix lambda operator. This makes (15) a possible LF for (14):

\[
\lambda w_1 \text{Adrian wants-w}_1 [\lambda w_2 [\text{a [jacket-w}_2 \text{like Malte’s jacket-w}_1]] [3 \text{ [PRO to buy-w}_2 t_3]]]
\]

In (15), the indefinite undergoes quantifier raising just to avoid a type mismatch and still remains within the scope of the attitude predicate.

We argue that (15) is an accurate report of Malte’s desire in the context provided for this example. Since Malte’s jacket in the actual world is a green Bench jacket, then being a jacket like Malte’s jacket in the actual world is being a green Bench jacket in any world. And, whoever wants to buy a jacket like Malte’s jacket in the actual world wants to buy a green Bench jacket.

To put it differently, (16) is equivalent to (15):

\[
\lambda w_1 \text{Adrian wants-w}_1 [\lambda w_2 [\text{a [green-w}_2 \text{Bench-w}_2 \text{jacket-w}_2]] [3 \text{ [PRO to buy-w}_2 t_3]]]
\]

The embedded clauses in (15) and (16), reproduced in (17) and (18), respectively, denote exactly the same set of possible worlds (assuming that \( w_1 \) is the actual world):

\[
\lambda w_2 [\text{a [jacket-w}_2 \text{like-w}_2 \text{Malte’s jacket-w}_1]] [3 \text{ [PRO to buy-w}_2 t_3]]
\]

\[
\lambda w_2 [\text{a [green-w}_2 \text{Bench-w}_2 \text{jacket-w}_2]] [3 \text{ [PRO to buy-w}_2 t_3]]
\]

And, since (16), as we said, straightforwardly describes the context, so does (15).

This analysis assumes that a cross-world comparison of predicates is possible. This assumption is independently motivated by the existence of reports like “I thought that your yacht is longer than it is” discussed in Russell (1905). Here, the degree to which the yacht is long in the attitude holder’s doxastic alternatives is compared to the degree to which the yacht is long in the actual world.

5.2. Predicting the Burj Khalifa example

We apply similar reasoning to (19), repeated below:

(19) Mary wants to buy a building with 192 floors.

Context: Mary is looking at the Burj Khalifa, which has 191 floors. No other currently existing building has more floors. Mary doesn’t know this. She also doesn’t know how many
floors Burj Khalifa has. She says, ‘Wow, I want to buy a building that’s even one floor higher!’

It seems uncontroversial that (20) correctly describes Mary’s desire because it represents the information that the speaker picks up directly from the context:

(20) Mary wants to buy a building that is one floor higher than Burj Khalifa.

We again assume ellipsis inside the embedded comparative construction. We reconstruct the elided material together with the world variable. We bind the variable by the matrix abstractor as illustrated in (21):

(21) \[ \lambda w_1 \text{Mary wants-w}_1 [\lambda w_2 [\text{a building-w}_2 \text{ that is one floor higher than Burj Khalifa is high-w}_2] [3 \text{ [PRO to buy-w}_2 \text{ t}_3]]] \]

As for the problematic (19), we provide it with the LF in (22):

(22) \[ \lambda w_1 \text{Mary wants-w}_1 [\lambda w_2 [\text{a building-w}_2 \text{ that has 192 floors-w}_2] [3 \text{ [PRO to buy-w}_2 \text{ t}_3]]] \]

We argue that (21) and (22) are equivalent because their embedded clauses denote the same set of possible worlds.

To put it differently, in any world it is the case that buying a building with 192 floors is buying a building that is one floor higher than Burj Khalifa is in the actual world.

We are aware of the fact that we are proposing a de dicto LF in (12) for a case in which Mary would not herself describe her desire in terms of buying a 192-floor building. Our proposal here assumes that as long as she can desire to buy a building that is one floor higher than the actual Burj Khalifa, the structure in (22) truly and objectively describes that desire.

5.3. The Intersective Predicate Generalization is not violated

Keshet (2008) introduces a restriction on the indexation of world variables known as The Intersective Predicate Generalization. According to this restriction, the world variables on intersecting predicates cannot carry different indices. Our analysis does not violate this restriction because the elided predicate that we reconstruct with a world variable bound by the matrix abstract does not intersect with a predicate in which the index on the world variable is bound locally.

In the Malte’s jacket example, the elided NP is inside a DP. In the Burj Khalifa example the elided predicate is a subconstituent inside a comparative construction and does not intersect with any other predicate either.

6. Other cases
In this section, we explore two remaining difficult cases discussed in the literature and show that the line of argumentation proposed in Section 5 can be successfully extended to those cases as well.

6.1. The Curfew Example

The first example (23) is Schwager’s (2011) adaptation of an example from Fodor (1970).

(23) The reporter wants to interview someone who broke the curfew.

The context that makes this example interesting is as follows.

Context: A reporter comes to a town N to interview people who could possibly witness a crime that happened after 6 p.m. She wants to talk to someone who was outside after 6 p.m. Unbeknownst to her, there is a curfew in N that starts at 6 p.m. and no one was out at that time.

If we try to give this sentence the LF in (24), where the world variable inside the DP *someone who broke the curfew* is bound by the matrix lambda abstractor, we will run into the same problem as the one observed in the Burj Khalifa example: the set of people who broke the curfew is empty in the actual world.

(24) \[
\lambda w_1 \text{The reporter-}w_1 \text{wants-}w_1 [\lambda w_2 \text{PRO to interview-}w_2 \text{some [one who broke-}w_2 \text{the curfew-}w_1]]
\]

As in all other cases, we observe that there are several predicates that can potentially carry world variables in this sentence. In particular, there is a DP inside the predicate *who broke the curfew* and the predicate inside this DP can carry a different world variable than the one on *break*. The LF we propose for (23) is given in (25).

(25) \[
\lambda w_1 \text{The reporter-}w_1 \text{wants-}w_1 [\lambda w_2 \text{PRO to interview-}w_2 \text{some [one who broke-}w_2 \text{the curfew-}w_1]]
\]

The report that is directly suggested by the context is given in (26) and its LF is shown in (27).

(26) The reporter wants to interview someone who was outside after 6 p.m.

(27) \[
\lambda w_1 \text{The reporter-}w_1 \text{wants-}w_1 [\lambda w_2 \text{PRO to interview-}w_2 \text{some [one who was outside after 6 p.m.-}w_2]\]]
\]

Since the interpretations of (28) and (29) below pick out the same set of worlds (assuming that \(w_0\) denotes the actual world), they are interchangeable in intensional contexts.

(28) \[
\lambda w_2 \text{PRO to interview-}w_2 \text{some [one who broke-}w_2 \text{the curfew-}w_0]\]

(29) \[
\lambda w_2 \text{PRO to interview-}w_2 \text{some [one who was outside after 6 p.m.-}w_2]\]
\]
Thus, the LFs in (25) and in (27) have equivalent interpretation and (23) can be truly used in the context.

If this analysis is on the right track, we need to accept the possibility that a law of one possible world can be broken (violated) in a different world. Breaking is understood here not as intentional violation, but merely as doing something that is not compatible with the law.

6.2 The same denomination example (Sudo, 2014)

The last example of a difficult case for the Standard Solution that we will discuss in this paper is from Sudo (2014). The example is given in (30).

(30) Mary thinks that Sue is Catholic.

This sentence is judged to be true in the following context.

Context: Mary is an atheist and quite ignorant in questions of religion. She does not differentiate between various branches of Christianity. She heard that our religious friend John started going out with a girl named Sue. Mary decided that Sue has to belong to the same denomination as John, but she does not know which. The speaker, unlike Mary, knows that John is Catholic.

The problem here is that Mary does not know that Sue is Catholic. Giving the predicate Catholic a world variable bound by the embedded matrix abstractor will not do. On the other hand, providing Catholic with a world variable bound by the abstractor of the main clause will result in the structure that violates Generalization X (Percus, 2000). According to this generalization, a world variable that a main predicate of a sentence carries has to be bound by the nearest lambda abstractor. The example from Percus (2000) that supports this generalization is given in (31).

(31) Mary thinks that my brother is Canadian.

If (31) could have an LF as the one given in (32), this sentence would be judged as true in a scenario where there is a person who Mary thinks is my brother (perhaps mistakenly) and who is a Canadian in the actual world, even if Mary does not know that. This sentence does not have this reading.

(32) [λw₂ Mary thinks-w₂ that [λw₁ my brother-w₁ is Canadian-w₁]]

Based on examples like (31), Percus concludes that there is a general restriction on binding the world variable on the main predicate of a sentence by a long distance lambda abstractor.

If the Generalization X is correct, the fact that (30) is acceptable in the described scenario is puzzling.
The solution proposed by Sudo (2014), like Schwager’s solution, appeals to a replacement principle. He suggests that a predicate (say, the following predicate: $[\lambda w.\lambda x. x$ and John belong to the same denomination in $w]$) can be replaced by another predicated in a belief-report as long as they are a contextually equivalent. The solution we propose here does not require any special replacement principles. It involves the following steps. First, we recover the belief-report that is picked up directly from the context (33).

(33) Mary thinks that Sue belongs to the same denomination as John.

Then we reconstruct the elided material and we get the LF given in (34).

(34) $[\lambda w_1 \text{Mary thinks-}w_1 [\lambda w_2 \text{Sue belongs-}w_2 \text{to the same denomination-}w_2 \text{as John belongs-}w_2 \text{to} ] ]$

We observe that (35) and (36) denote the same proposition. This is because in every possible world having the same denomination as the denomination that John has in the actual world is being Catholic.

(35) $[\lambda w_2 \text{Sue belongs-}w_2 \text{to the same denomination-}w_2 \text{as John belongs-}w_0 \text{to} ]$

(36) $[\lambda w_2 \text{Sue is Catholic-}w_2 ]$

This means that we can substitute (36) for (35) and the report has to stay true. If so, then (30) must be true if it is understood to have the LF in (37):

(37) $[\lambda w_1 \text{Mary thinks-}w_1 [\lambda w_2 \text{Sue is Catholic-}w_2 ] ]$

Our solution to this puzzle does not violate Generalization X, because the main predicate of the sentence “Catholic” is interpreted de dicto.

7. Conclusion

In this paper, we considered the challenging cases of third readings of indefinites in attitude reports. We argued that all of the seemingly problematic examples can be naturally accounted for by the Standard Solution. In some of the cases, it was enough to reconstruct the elided material. In other cases, we had to consider a report that is directly suggested by the context, reconstruct the elided material and observe that the report that is considered to be problematic is semantically equivalent to it.

In our analysis, we used a principle of substitutivity that allowed us to replace one report with another. We believe that the principle we used is essentially different from the ones suggested in Schwager (2011) and Sudo (2014). The principle of substitutivity that we made appeal to is not a part of the theory that we suggest but is a metatheoretic principle–principle of compositionality—that is assumed by everyone doing compositional semantics.

Appendix
Of all the examples discussed above, the Standard theory applies in the most straightforward way to the case of Buyer’s intensions and the Curfew example. In both of those cases, the relevant report contains a predicate that is evaluated with respect to the actual world. We repeat the two sentences from the earlier sections in (1) and (3) together with their LFs below.

(1) Adrian wants to buy a jacket like Malte’s.  
(2) \[ \lambda w_1 \text{Adrian wants-}w_1 [\lambda w_2 \text{to buy-}w_2 \text{ a [jacket-}w_2 \text{like-}w_2 \text{Malte’s jacket-}w_1]] \]  
(3) The reporter wants to interview someone who broke the curfew.  
(4) \[ \lambda w_1 \text{The reporter wants-}w_1 [\lambda w_2 \text{PRO to interview-}w_2 \text{some [one who broke-}w_2 \text{the curfew-}w_1]] \]  

The more controversial cases are the cases of Burj Khalifa and Sue’s Catholicism. For the case of Burj Khalifa, repeated in (5), we proposed the LF in (6):

(5) Mary wants to buy a building that has 192 floors.
(6) \[ \lambda w_1 \text{Mary wants-}w_1 [\lambda w_2 \text{PRO to buy-}w_2 \text{a building-}w_2 \text{that has 192 floors-}w_2] \]  

We observed that (6) was equivalent to (7), which was a possible LF for a report supported by the given context and provided in (8):

(7) \[ \lambda w_1 \text{Mary wants-}w_1 [\lambda w_2 \text{PRO to buy-}w_2 \text{a building-}w_2 \text{that is one floor higher-}w_2 \text{than Burj Khalifa is high-}w_1] \]  
(8) Mary wants to buy a building that is one floor higher than Burj Khalifa.

The issue that someone might find bothersome here can be described as follows. In (6), the indefinite is interpreted under the intensional verb and the predicate inside this indefinite is bound by the embedded lambda operator. So, under this analysis, (5) is a pure de dicto report.

However, the context was set up in such a way that Mary does not know the height of Burj Khalifa and she would not accept (5). Moreover, double vision scenarios similar to the famous examples known from (Quine, 1956) can be constructed in this case. For example, it is conceivable that in a different context when she is shown a project of a building that has 192 floors, the same person Mary says, “I don’t want to buy a building that is this high”.

Similarly, in the example with Sue’s Catholicism, we proposed the LF given in (9) for the sentence in (10):

(9) \[ \lambda w_1 \text{Mary thinks-}w_1 [\lambda w_2 \text{Sue is Catholic-}w_2 ] ] \]  
(10) Mary thinks that Sue is Catholic.
Again, we observed that its interpretation is equivalent to that of (11) which is a possible LF for the report directly suggested by the context and given in (12):

\[
(11) \quad [\lambda w_1 \text{Mary thinks-w}_1 [\lambda w_2 \text{Sue belongs-w}_2 \text{to the same denomination-w}_2 \text{as John belongs to-w}_1 ]]
\]

(12) Mary thinks Sue belongs to the same denomination as John.

However, like in the previous case, (9) does not contain any predicate in the embedded clause that is evaluated transparently. This is a \textit{de dicto} report that Mary herself would not accept.

And, even for the Curfew example, which does not require this kind of unusual \textit{de dicto} analysis, it might still be argued that, in our proposed analysis, the predicate “break” is evaluated with respect to the worlds of the reporter even though the reporter does not know about the existence of a restriction that is being broken.

We explored the account that the Standard Solution could provide for all these cases. The abovementioned worrisome aspects of the analysis are the price that we have to pay if we want to apply the Standard Solution to all of the problematic cases. Yet, it is possible that the analysis in terms of the third readings might not be applicable to these last three cases in the first place.

Schwager (2011) makes an observation that all the hard cases except one, the Malte’s jacket case, can be handled in terms of the \textit{de qualitate} analysis. In a nutshell, the analysis in terms of \textit{de qualitate} would require interpreting the property in the restrictor of the indefinite (“jacket like Malte’s”) in the transparent position. The sentence is predicted to be true if there is a concept such that in the actual world it picks the property of being a jacket like Malte’s (the property given in (13)) and in the worlds of Adrian’s doxastic alternatives picks a property of being a green bench jacket. This concept can be defined technically, however, it cannot reflect the way the property is cognitively given to the attitude holder. The scenario is set up in such a way that the property “be a jacket like Malte’s” is not given to the attitude holder under any guise, Adrian does not have any cognitive contact with it.

\[
(13) \quad [\lambda w.\lambda x. x \text{ is jacket-like-Malte’s in w}]
\]

In this paper, we have shown that there is elided material in this report and when this material is taken into account, this example is no longer a hard case but is just another illustration of a third reading in a classical sense.

As for the remaining cases, it might, indeed, be quite possible to account for them in terms of a \textit{de qualitate} analysis (Cresswell and Von Stechow, 1982) or in terms of generalized concept generators (Baron, 2015). However, we are not convinced that \textit{de qualitate} analysis is necessary here. In the remaining part of this Appendix, we would like to outline an
alternative *de re*\(^3\) analysis of the three cases. We believe that, in each of the cases it is possible to find something that is not a property that can be interpreted as a *res* of a *de re* construal.

We suggest that, in the Burj Khalifa case, it is 192 that is interpreted *de re*. A possible LF for this example is given in (14). Following Percus and Sauerland (2003) and Charlow and Sharvit (2014), a variable \(G\) of the concept generator type is merged as a sister to 192 and is bound by the lambda abstractor at the edge of the embedded clause. A concept generator takes a number and returns a concept - a function from a world to a number. Quantification over concept generators is introduced by the intensional verb and it is relating the concept generator and the attitude holder. The resulting interpretation is given in (15).

\[
\lambda w_1 \text{Mary wants-} w_1 [\lambda G \lambda w_2 \text{PRO to buy-} w_2 \text{a building-} w_2 \text{with } [[G 192] w_2 \text{floors-} w_2]]
\]

\((14)\)

\[
\|((14))\|_w^G = 1 \text{ iff } \exists G \text{ such that } G \text{ is a concept generator for Mary in } w \land \forall w' \in \text{Desire-Alt (Mary, w): } \exists y. y \text{ is a building in } w' \text{ and } y \text{ has } G(192)(w') \text{ floors in } w' \text{ and Mary is buying } y \text{ in } w'.
\]

One possible concept generator will map the number 192 to the concept given in (16).

\[
[\lambda w'. \text{the number of floors in the building Mary is looking at in } w' +1]
\]

The belief-report in case of Sue’s Catholicism can be represented as a *de re* attitude with respect to Catholicism under the assumption that the adjective “Catholic” can be further decomposed into two parts, one of which stands for “Catholicism” and the other one for “be the follower of”. The truth conditions that (10) will be assigned in that case are given in (17):

\[
\|((10))\|_w^G = 1 \text{ iff } \exists G \text{ such that } G \text{ is a concept generator for Mary in } w \land \forall w' \in \text{Dox(Mary, w): } \exists y. y \text{ is a building in } w' \text{ and } y \text{ has } G(\text{Catholicism})(w') \text{ floors in } w' \text{ and Sue is a follower of } G(\text{Catholicism})(w').
\]

A possible context generator in this case could be the one that maps “Catholicism” into the concept given in (18).

\[
[\lambda w'. \text{the religion that John has in } w']
\]

As for the Curfew example, Schwager (2011) does not discuss it in much detail. She says, however, that a *de re* analysis is not applicable, if the true *de dicto* report is (19) and what is to be interpreted as a *de re* report is (20).

\[(19)\] The reporter wants to talk to someone who was outside after 6 p.m.

\[(20)\] The reporter wants to talk to someone who broke the curfew.

\(^3\) *De re* in this appendix is understood as a *de re* construal interpretation. It is a different notion of *de re* than the one used in Section 2, where it simply referred to the fact that an indefinite took scope above the intensional verb.
Under a *de dicto* interpretation, (19) asserts that the reporter interviews someone who was outside after 6 p.m. in each of her desire worlds. Under a *de re* interpretation of (20), only the speaker knows that 6 p.m. is the time of the curfew.

It is not immediately clear why a *de re* analysis would not be applicable in this case. Suppose the relevant concept is

\[
19 \text{ [\lambda w'. the boundary of 6 p.m. in } w' \text{]}
\]

This concept maps any possible world to 6 p.m. in that world by default. However, in the actual world, the boundary of 6 p.m. is identical to the boundary of the curfew, i.e. to the curfew itself. Therefore, breaking the 6 p.m. boundary (by being outside) in the actual world is breaking the curfew in the actual world.

We thus predict the following *de re* LF for (20):

\[
20 \text{ [\lambda w_1 \text{ The reporter-}w_1 \text{ wants-}w_1 \lambda G \lambda w_2 \text{ PRO to interview-}w_2 \text{ someone who broke-}w_2 [G[the curfew-}w_1 \text{] } w_2 \text{]]}
\]

We conclude that if the ideas expressed here are on the right track, the so-called hard cases of third readings either can be straightforwardly accounted for in terms of the Standard Solution or they don't qualify for the analysis in terms of the Standard Solution to begin with but can be captured by a *de re* interpretation.

**References**


Abstract. We investigate the sentence-final particle ho from Cantonese, which can stack on top of other sentence-final particles indicating various types of speech acts. We argue that ho is a higher level question operator that operates at the level of speech acts. More concretely, it takes a speech act (assertion or question) and returns a new interrogative speech act asking whether the input speech act can be felicitously performed by the addressee. We take the presence of this kind of higher level question operator in natural language as novel evidence that a mechanism for operating on speech acts is needed. Building on Farkas and Bruce (2009), Rawlins (2010), Bledin and Rawlins (2017), we develop a mechanism in the style of Update Semantics for operating on speech acts.

Keywords: speech acts, sentence-final particles, Cantonese, update semantics.

1. Introduction

The function of mapping from the semantic content of an utterance to its convention of use (a division of labor first made by Frege (1956)) has been attributed to abstract speech act operators (also known as force operators), such as ASSERT, QUESTION, and COMMAND. These operators have been traditionally assumed to occupy the highest echelons of the clausal periphery. The precise formulation of these operators has attracted a lot of attention from semanticists, as they are crucial for formalizing the diverse discourse functions of speech acts (Farkas and Bruce, 2009; Farkas and Roelofsen, 2017; Malamud and Stepheson, 2015; Krifka, 2015). These high operators usually come packaged with two assumptions: i) they are not embeddable under other elements, and ii) they belong to the realm of pure pragmatics and not compositional semantics. Recent research in both semantics and syntax have challenged these assumptions (Krifka, 2015; Davis, 2011; Wiltchko, 2017; Heim et al., 2016). Based on evidence from a language with a rich array of sentence-final particles (SFPs), Cantonese, we argue in this paper that not only are abstract speech operators embeddable, it is also the case that we need compositional mechanisms in these high regions of the clause. We will investigate the SFP stacking phenomenon, and argue that such grammaticalized operations on speech act operators reveal the need for a system that can compose the content of an utterance with multiple particles that update the discourse in a number of different, non-trivial ways.

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2. The empirical landscape

2.1. Primary sentence-final particles in Cantonese

Cantonese is a language with a large repository of sentence-final particles. These sentence-final particles are standardly taken to be elements that serve the myriad functions that various intonational contours serve in Indo-European languages such as English (Wakefield, 2011). As such, one of their roles is to indicate illocutionary force, or speech acts (Cheung, 1972; Luke, 1990; Matthews and Yip, 2011; Fung, 2000). Note that different sentence-final particles may indicate the same speech act with slightly different flavors. Since the purpose of this subsection is to introduce the basic particles to be taken up later, we only include a small set of particles that we will use later. To express an assertion, the particle *gaa* may be used, as shown in (1).

\[(1)\] Aaman sik haa  
Aaman eat shrimp **ASSERT**  
‘Aaman eats shrimp.’  

When expressing an interrogative, one may choose from a range of sentence-final particles, depending on the type of the interrogative. For example, a polar question may be accompanied by the particle *maa*:

\[(2)\] Aaman sik haa  
Aaman eat shrimp **POLQ**  
‘Does Aaman eat shrimp?’  

To mark a *wh*-question or an alternative question, *ne* may be used, as shown in (3a) and (3b), respectively.

\[(3)\]  
\[a.\] Bingo sik haa  
who eat shrimp **WHQ**  
‘Who eats shrimp?’  

\[b.\] Aaman sik haa  
ding sik ju  
Aaman eat shrimp or  
eat fish **WHQ**  
‘Does Aaman eat shrimp or fish?’

It is worth noting that sentence-final particles in general are an optional device to mark clause types. Strictly speaking, one can still get the intended clause type without using any sentence-final particle, especially in a more formal speech context or a written context. However, native speakers feel that having sentence-final particles helps make utterances more natural.

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\[2\] We gloss this set of basic particles based on the type of speech acts they indicate, such as **ASSERT** for assertive particles, **POLQ** for polar question particles, and **WHQ** for *wh*-question and alternative question particles. All other sentence-final particles that are not the concern of this paper are glossed as SFP.
Now that we have acquainted ourselves with the primary sentence-final particles in Cantonese, we are ready to turn to a particle that may stack on top of a primary particle. The particle of interest is ho. We introduce ho’s interactions with different speech acts: with assertions in section 2.2, and with questions in 2.3.

2.2. Ho embedding assertions

Ho is an interrogative sentence-final particle in Cantonese. It is special because it may stack on top of another sentence-final particle, as shown in (4).

(4) Aaman sik haa gaa ho?
   'Aaman eats shrimp. Right?'

In this example, ho stacks on the assertion particle gaa. It has the effect of turning the assertion into a question, as pointed out in previous studies (Sybesma and Li, 2006; Lam, 2014; Tang, 2015). Following Lam (2014), this type of questions is roughly translated as an assertion plus a confirmation tag ‘right?’.

An assertion+ho question admits a range of responses also admitted by an ordinary polar question. For example, one may choose an affirmative answer like (5a), a negative answer like (5b), or indicate their ignorance with (5c).

(5) a. Hai aa. yes SFP
   ‘Yes, he does.’

   b. Mhai aa no SFP
   ‘No, he doesn’t’

   c. N o mzi wo I not.know SFP
   ‘I don’t know.’

At this point, one may be tempted to analyze ho as a polar question marker similar to maa. However, these two particles exhibit crucial differences with respect to their ability to stack on a primary particle. Observe that unlike ho, the polar question particle maa may not stack on an assertion particle, as evidenced by the unacceptability of (6).

(6) *Aaman sik haa gaa maa?
   Intended ‘Does Aaman eat shrimp?’

We take the difference in stackability to be semantically grounded. While ordinary question parti-

---

3Gaamaa may be used as a complex assertive particle to indicate obviousness of the asserted content. In this case, it is a fusion of two assertive particles ge and amaa, rather than a fusion of an assertive particle and a polar question particle, as suggested by Matthews and Yip (2011).
cles like *maa* signal the mapping from semantic content to interrogative speech act, *ho* is a ‘**higher level**’ question particle embedding speech act rather than just a semantic content. If this view is correct, then the ungrammaticality of (6) is expected, as *maa* indicates a transition from semantic content to a speech act—the input is already a speech act, as indicated by the presence of a sentence-final particle, so, in a sense, it is ‘too big’ to be operated on by *maa*. By contrast, *ho* is perfectly happy to operate on a unit already marked by a sentence-final particle, as shown in (4), because it is a ‘**higher level**’ question particle, one that takes a speech act as its input. We will undertake a formalization of the property of being a ‘**higher level**’ question operator in Section 3.3.

In addition, when *ho* takes an assertive speech act as its input, it indicates a bias towards the asserted content, another trait not shared by the polar question particle *maa*. Imagine a neutral context in which someone is trying to ask a pedestrian to fill out a survey. (7) may be used felicitously to make such a request, but (8) may not.

(7) Nei jau *sigaan maa*?
   you have time POLQ
   ‘Do you have time?’ *Polar question*

(8) #Nei jau *sigaan gaa ho*?
   you have time ASSERT HO
   ‘You have time. Right?’ *Assertion + ho*

If (8) is used, it conveys the message that the speaker has prior belief that the addressee has time to help, which comes across as impolite in this context. On the contrary, (7) does not have such a bias, so it does not have connotations of impoliteness in the same context.

### 2.3. *Ho* embedding questions

An even more interesting distributional fact is that *ho* may readily embed a *wh*-question or an alternative question (Lam, 2014). Consider the following examples:

(9) Bingo sik haa *ne ho*?
    who eat shrimp WHQ HO
    ‘Who eats shrimp? Do you share the same question?’ *Wh-question + ho*

(10) Aaman sik haa *ding sik jyu ne ho*?
    Aaman eat shrimp or eat fish WHQ HO
    ‘Does Aaman eat shrimp or fish? Do you share the same question?’ *Alt question + ho*

---

4*Ho* may also embed other types of questions, but a more sophisticated context is required. We discuss this issue in Section 4.
When stacked on top of a question particle, as in (9)–(10), *ho* changes the question introduced by the lower question particle into another question asking roughly whether the addressee would rationally ask the same embedded question, irrespective of the type of the question. Since using a confirmation tag after a question does not sound felicitous to native speakers of English, we chose to translate the contribution of *ho* in interrogative cases by using another question, i.e., ‘do you share the same question?’

We would like to point out two notable facts about *question-ho* constructions. First, the range of responses this construction admits is quite different from the ones admitted by just using the embedded questions. Consider some responses to a *wh*-question like (11), illustrated in (12a)–(12c).

(11) Bingo sik haa ne?
    *who eat shrimp* WHQ
    ‘Who eats shrimp?’

(12) a. Aaman lo.  
    Aaman SFP
    ‘Aaman.’

b. *ŋo mzi wo.*  
    I not.know SFP
    ‘I don’t know.’

c. #Hai lo.  
    yes SFP
    ‘Yes.’

If one knows the answer to (11), they may directly answer it, as in (12a). Alternatively, if one does not know the answer, they may indicate their ignorance with (12b). However, one may not answer *hai (lo) ‘yes’* to such a question.5

After such a *wh*-question is embedded under *ho*, as in (13), the range of felicitous responses changes, as shown in (14a) - (14d).

(13) Bingo sik haa ne ho?
    *who eat shrimp* WHQ HO
    ‘Who eats shrimp? Do you share the same question?’

(14) a. Aaman lo.  
    Aaman SFP
    ‘Aaman.’

b. #*ŋo mzi wo.*  
    I not.know SFP
    ‘I don’t know.’

c. *ŋo dou mzi wo.*  
    I also not.know SFP
    ‘I don’t know either.’

d. Hai lo.  
    yes SFP
    ‘Yes.’

5*Hai (lo) ‘yes’* may be used when a continuation like I don’t know either is added. Anticipating the discussion of *ho* stacking on top of a question, which readily admits such a response without the need of a continuation like I don’t know either, we suggest that a canonical question may be turned into a higher, speech act-level question via some pragmatic means. The continuation can be seen as a trigger of the pragmatic means.
It is still possible to directly answer the *wh*-question, as shown in (14a). However, it is no longer felicitous to just answer *I don’t know*, as shown in (14b). To indicate ignorance, the addressee has to show agreement with the speaker’s ignorance, by using a response corresponding to *I don’t know either*, as shown in (14c). Moreover, rather surprisingly, it is felicitous to answer *hai (lo) ‘yes’*, as shown in (14d).

Secondly, when *ho* embeds a question, it changes the felicity condition associated with the embedded question. Generally speaking, a speaker uses an interrogative speech act to signal the belief that the addressee may be able to answer the question. However, a speaker signals just the opposite when he or she uses *ho* to embed an interrogative speech act. That is, the speaker thinks it is possible that the addressee may *not* be able to answer the embedded question. We illustrate the contrast in the two types of questions with two storyboard scenarios borrowed from the UBC Syntax of Speech Acts Lab.

**Scenario A:** ‘My friend was puzzled, too.’

![Figure 1](image1.png)

Figure 1: A famous scientist gave a talk on astrophysics. A, as a linguist, couldn’t follow the talk. A’s friend B was a poet, and it seemed to A that B did not understand the talk either.

**Scenario B:** ‘My friend understood this.’

![Figure 2](image2.png)

Figure 2: A famous scientist gave a talk on astrophysics. A, as a linguist, cannot follow the talk. However, A’s friend B was a physicist and it seemed to A that B understood the talk quite well.

In the first scenario, A did not understand the content of the talk and thought that B did not understand it either. In this context, using a *wh*-question+*ho* like (16) is felt to be more felicitous than using a *wh*-question like (15), if A did not have obnoxious intentions. If A was being obnoxious and wanted to insult B for her ignorance, then he may use (15).

In the second scenario, A did not understand the content of the talk but thought that B understood it well. To inquire the content of the talk, it is more felicitous to use a *wh*-question like (15). Again, it is possible to use the *wh*-question+*ho* strategy in (16), but in a marked way. This time
the markedness comes from the feeling that A was trying to get B to explain the content of the talk without admitting that B was in a privileged position to explain it.

(15) Keoi gong me ne?  
he say what WHQ
‘What did he say?’
(Preferred in Scenario B: My friend was puzzled, too.)

(16) Keoi gong me ne ho?  
he say what WHQ HO
‘What did he say? Do you share the same question?’
(Preferred in Scenario A: My friend understood it.)

2.4. Synthesizing the two paradigms

The properties of ho-questions discussed in the previous subsections raise two theoretically interesting questions. First, what does it mean for a particle to operate on an assertion or a question? Assertions and questions are speech act-level objects. Operating on these objects at the very least calls for a mechanism for manipulating speech acts. While the traditional view is that speech acts are inoperable, pragmatic objects, this view has been challenged in recent years, by scholars such as Krifka (2015), Davis (2009), and Heim et al. (2016). These scholars hold the view that speech acts should in principle be amenable to semantic operations just like other semantic objects. The fact that there are sentence-final particles operating on speech acts provides independent support for such a view.

Secondly, questions and assertions make different contributions to context, but ho indiscriminately operates on both types of speech acts, not minding their differences. Nonetheless, ho-questions have quite different interpretive properties depending on whether the embedded speech act is an assertion or a question. In the case of an assertion-ho-question, it asks for confirmation of the asserted content; in the case of a question-ho-question, it asks whether the addressee shares the question or not. Logically speaking, one could posit two instances of ho that embed assertions and questions, respectively. If we make this move, however, we miss capturing a strong intuition that native speakers of Cantonese have: ho-questions are really a uniform class and that’s why the same particle is used to embed assertions and questions.

We argue in the rest of the paper that there is no need to posit two different ho’s, as long as we take seriously the sentence-final particle stacking paradigm and treat ho as a higher-level question particle, one that embeds speech act rather than semantic content.

This way of cutting up the pie straightforwardly addresses the first question: ho may embed a question or an assertion because, as a speech act level question particle, it is in a position to do
so. In addition, treating *ho* as a speech act level question particle buys us more than just a way to account for sentence-final particle stacking. It actually makes available a level, i.e., the speech act level, with which we can afford a unified semantics of *ho* in both the assertion embedding and question embedding contexts. We develop the concrete semantics of *ho* and a mechanism of speech act embedding in Section 3.

3. Proposal

We propose that *ho* embeds a speech act, which can be an assertion or a question. Following the dynamic semantics of discourse initiated in Farkas and Bruce (2009) and further developed in Rawlins (2010), Farkas and Roelofsen (2017) and Bledin and Rawlins (2017), speech acts are derived by combining speech act operators with corresponding semantic content. In section 3.1, we will lay out the formal preliminaries of the framework and define the speech act operators **assert** and **quest**. The speech act operators consist of two components: (a) an at-issue component, which instructs how a speaker updates the input context by acting on some semantic content; and (b) a non-at-issue component, which is a set of felicity conditions, which tests whether the speech act is felicitously performed. The semantics of *ho* is given in section 3.3. Briefly speaking, *ho* inherits the felicity condition of the speech act that it embeds, and generates a question for the addressee asking whether s/he is also able to felicitously perform the embedded speech act. This analysis can successfully capture the empirical patterns of *ho*, as demonstrated in section 3.3.1 and 3.3.2.

3.1. Preliminaries

Many studies have defined discourse contexts as a tuple consisting of different conversational components, like the Stalnakerian context set, a set of participants, commitment sets and so on (Gunlogson, 2001; Farkas and Bruce, 2009; Rawlins, 2010). Since not all of the conversational components are useful for our purpose, we define a context as a simple pair, consisting of a context set and a stack:

\[(17)\text{ A context } c \text{ is a pair of } \langle \text{cs}_c, \mathcal{T}_c \rangle, \text{ where} \]
\[a. \text{ cs}_c \subseteq W \text{ is a set of worlds (the context set)} \]
\[b. \text{ } \mathcal{T}_c \text{ is a stack of issues, i.e., a set of propositions.} \]

Following Stalnaker (1978, 2002) and many others, the context set **cs** includes the possibilities that are compatible with what is known to the discourse participants for the purposes of the conversation. \(\mathcal{T}_c\) is a stack of issues, i.e., a set of propositions, comparable to the Table component in Farkas and Roelofsen (2017) (cf. Farkas and Bruce, 2009; Malamud and Stepheson, 2015). The stack keeps a history of the utterances, i.e. the proposals for updating the context set, made by the discourse participants.\(^6\) The motivation for this component, due to Farkas and Bruce (2009), is

\(^6\)Other formulations may involve more fine-grained structuring of the stack to separate assertions and questions, for example, Rawlins (2010), Bledin and Rawlins (2017). We adopt a simpler version for our purposes.
that an assertion does not directly update the context set, but rather is a proposal to do so.

In this spirit, we define the speech act operator \textit{assert} as shown below. It combines with a proposition and returns a context change potential, i.e., a function from an input context to an output context. The subscripts on the operator indicate the world parameter and the speaker parameter relative to which the speech act is evaluated.

\begin{equation}
{c + \text{assert}_{w,s,}(p) = \langle cs_c, \text{push}\left(\{ cs_c \cap \{ w' \mid p(w') \} \right), \mathcal{T}_c \rangle}, \text{defined only if} \ \ s_c \text{ believes that } p \text{ is true in } w \end{equation}

\textit{push} is a standard operation on stacks, formally defined as follows (see Farkas and Bruce (2009) for similar uses).

\begin{equation}
\text{push}(e, \mathcal{T}) = e \cdot \mathcal{T}, \text{ represents a new stack with } e \text{ added to the top of } \mathcal{T}. \end{equation}

According to (18), making an assertion involves pushing a proposal onto the stack. The proposal is modeled as a (singleton) set of contexts updated with the asserted proposition (cf. the \textit{projected set} in Farkas and Bruce (2009)). In other words, an assertive update does not update the context set immediately, but rather makes a proposal pending the audience’s response (confirm/reject). An assertive update is evaluated relative to two parameters, a possible world in which the speech act is defined and the author of the speech act.

This operator also comes packaged with an important felicity condition, which tracks the mental state of the speaker. Specifically, the felicity condition captures the intuition that a person appropriately asserts \( p \) in \( w \) only if they believe \( p \) is true in \( w \). Thus, an assertive update is felicitous only in worlds in which the speaker believes in the validity of \( p \) and undefined otherwise.\(^7\)

Moving on to questions, our questioning update is also formalized with use of a speech act operator—\textit{quest}, defined as in (20). This operator takes a question \( Q \) and returns a context change potential. In this paper, we follow Hamblin/Karttunen’s approach (Hamblin, 1973; Karttunen, 1977) and assume that a question denotes a set of propositions. Each proposition in the set can potentially update the context set. Therefore, asking a question involves making a proposal that contains multiple potential updates. Then, the addressee answers the question by choosing one update from the proposal.

\(^7\)We are aware that this felicity condition makes a direct connection between true belief and the performance of an assertion, which cannot accommodate prevarication contexts (p.c. Manfred Krifka). In order to allow assertions in prevarication contexts, we can switch to a weaker felicity condition:

\begin{equation}
{c + \text{assert}_{w,s,}(p) = \langle cs_c, \text{push}\left(\{ cs_c \cap \{ w' \mid p(w') \} \right), \mathcal{T}_c \rangle}, \text{defined only if} \ \ s_c \text{ wants her fellow discourse participants to believe that she believes } p \text{ is true in } w \end{equation}

This switch has no bearing on our central thesis, and hence we use the stronger version for the sake of simplicity.
The questioning update has two felicity conditions. Presumably, a questioner can appropriately ask $Q$ only if she does not already know the answer to $Q$.\(^8\)

3.2. Formalizing Cantonese sentence-final particles

Before laying out the formal analysis of $ho$, we will apply the formal tools defined in the last section to distinguish declaratives and questions from Cantonese. Consider (21).

(21)  
\begin{align*}
\text{Aaman sik haa gaa.} \\
\text{Aaman eat shrimp ASSERT} \\
\text{‘Aaman eats shrimp.’}
\end{align*}

We assume that the sentence final particle $gaa$ lexically encodes $\text{assert}$. The declarative sentence, then, has the following translation:

\begin{align*}
(22) \quad c + \text{assert}_{w,sc}(\llbracket \text{Aaman eat shrimp} \rrbracket) = \\
\langle cs_c, \text{push}(\llbracket cs_c \cap \{w' | p(w') \} | p \in Q \rrbracket, Tc) \rangle \\
\text{defined only if } sc \text{ believes Aaman eats shrimp in } w
\end{align*}

Accordingly, (21) means that the speaker proposes in world $w$ to update the input context with the proposition denoted by $\text{Aaman eats shrimp}$. If the assertion is appropriately made in the world, the speaker must believe Aaman eats shrimp.

Turning to questions, we take (23) as an example. Like $gaa$, the question particle $ne$ is also assumed to contain $\text{quest}$ in its lexical semantics. Assuming that the possible answers to the question are Aaman eats shrimp and Waazai eats shrimp, we translate the question as (24).\(^9\)

(23)  
\begin{align*}
\text{Bingo sik haa ne?} \\
\text{who eat shrimp WHQ} \\
\text{‘Who eats shrimp?’}
\end{align*}

\(^8\)Note that these felicity conditions can be suspended in exam/quiz contexts and other non-standard scenarios like the rhetorical use of questions, and we have no new insight to offer regarding how suspension is allowed.

\(^9\)For simplicity, we assume an unstructured domain of possible answers. However, our analysis is compatible with a more structured domain containing pluralities, as argued by Dayal (1996).
(24) \[ c + \text{quest}_{w,s_c}([\text{who eats shrimp}]) = \]
\[
\left< \text{cs}_c, \text{push} \left( \left\{ \begin{array}{c} \text{cs}_c \cap \{ w' | \text{Aaman eat shrimp in } w' \} \\
\text{cs}_c \cap \{ w' | \text{Waazai eat shrimp in } w' \} \end{array} \right\}, \mathcal{T}_c \right) \right>
\]
defined only if \( s_c \) does not know the answer to \([\text{who eats shrimp}] \) in \( w \)

With the use of question (23), the questioner proposes that the input context can be updated with
the proposition denoted by \( \text{Aaman eats shrimp} \) or the one denoted by \( \text{Waazai eats shrimp} \). If the
question is appropriately asked, the questioner must want to know its answer, as dictated by its
felicity condition.

A note for clarification before we move on: although we take SFPs to lexically encode speech act
operators like \textit{assert} and \textit{quest}, we by no means imply a unique mapping between a SFP and
a speech act operator. As mentioned in Section 2.1, a sentence may be interpreted as a question
or an assertion even without any SFP. Additionally, there is more than one assertion particle and
question particle in Cantonese. In fact, in Section 4, we discuss two variants of the \textit{quest} operator
with slightly different felicity conditions.

3.3. Semantics of ho

Armed with these definitions, we can now present our analysis of \( ho \). Consider the definition in
(25), in which \( A \) is a variable for the speech act embedded by \( ho \).

(25) \[ c + ho(A)_{w,s_c,a_c} = \left< \text{cs}_c, \text{push} \left( \left\{ \begin{array}{c} \text{cs}_c \cap \{ w' | A_{w'}{a_c} \text{ is defined in } w' \} \\
\text{cs}_c \cap \{ w' | A_{w'}{a_c} \text{ is undefined in } w' \} \end{array} \right\}, \mathcal{T}_c \right) \right> \]
defined only if \( A_{s_c} \) is defined in \( w \)

This definition says: \( ho \) takes the speech act \( A \) as its argument; then, it forms a new question
asking whether the addressee \( a_c \) can felicitously perform \( A \) or not; this new question is formalized
as a set of two possible updates; one is the intersection of the context set \( \text{cs}_c \) and the worlds in
which \( a_c \)'s performance of \( A \) is defined, i.e., updating \( \text{cs}_c \) with the proposition that \( a_c \) felicitously
performs \( A \); the other is the intersection of \( \text{cs}_c \) and the worlds in which \( a_c \)'s performance of \( A \) is
undefined, i.e., updating \( \text{cs}_c \) with the proposition that \( a_c \) does not felicitously perform \( A \); finally,
the composition of \( ho \) and \( A \) returns a new speech act, which is defined only if the speaker \( s_c \) can
felicitously perform \( A \). Thus, \( ho \) informally expresses two facts: i) that the speaker can felicitously
perform a speech act and, ii) they are asking whether the addressee can felicitously perform the
same speech act.
3.3.1. Assertion + ho

Let’s use the familiar data point below as a concrete example to elaborate how the definition in (25) captures the Cantonese facts.

(26) Aaman sik haa gaa ho?
    Aaman eat shrimp ASSERT HO
    ‘Aaman eats shrimp. Right?’

In this example, ho is attached to the assertion marked by gaa. With use of (25), we translate the sentence as follows:

(27) \( c + ho(\text{assert}([\text{Aaman eat shrimp}]))_{w,s,a_e} = \)
    \[
    \left\{ \begin{array}{l}
    \text{cs} \cap \{ w' \mid \text{assert}_{w',a_e}([\text{Aaman eat shrimp}]) \text{ is defined in } w' \}, \\
    \text{cs} \cap \{ w' \mid \text{assert}_{w',a_e}([\text{Aaman eat shrimp}]) \text{ is undefined in } w' \}
    \end{array} \right\}, \mathcal{F}_c
    \]
    defined only if \( \text{assert}_{w,s,a_e}([\text{Aaman eat shrimp}]) \) is defined in \( w \)

According to the felicity condition of \text{assert}, as in (18), if it is defined for \( a_e \) to assert Aaman eats shrimp, then \( a_e \) believes Aaman eats shrimp. Conversely, if it is undefined for \( a_e \) to assert Aaman eats shrimp, then \( a_e \) does not believe Aaman eats shrimp. Based on these deductions, we can predict the possible responses to (26), which are described in section 2.2 and repeated here:

(28) a. Hai aa.          b. Mhai aa         c. ņo mzi wo
    yes ASSERT             no ASSERT          I not.know SFP
    ‘Yes, he does.’       ‘No, he doesn’t’   ‘I don’t know.’

When the addressee responds with (28a), it indicates that they also believe that Aaman eats shrimp. If the addressee does not share this belief with the speaker, they may know that Aaman does not eat shrimp or they may be ignorant about the propositional content. In the former case they can use (28b) to answer the question, while in the latter case they can use (28c).

In Section 2.2, we noted that an assertion-ho question bears a bias towards the asserted proposition, making it less felicitous than a default polar question (with maa) in a neutral context (see example (7) and (8)). The felicity condition of attaching ho to an assertion can capture the presence of this bias. In (27), if the speaker can felicitously assert that Aaman eats shrimp, then they believe that this proposition is true. It then entails that the speaker does not believe that the counterpart of the asserted proposition \text{Aaman does not eat shrimp} is true. A consequence of this belief in the validity of \( p \) over \( \neg p \) results in a bias towards \( p \) over \( \neg p \).\(^\text{10}\)

\(^{10}\) Without going into a lot of detail, the definition of bias we adopt for our purposes here is one that treats the asserted nucleus of a question as more salient in the speaker’s doxastic domain than its counterpart. See Roelofsen and van Gool (2010), Biezma and Rawlins (2012), Krifka (2015), Xu (2017), Bhadra (2017) among others.
3.3.2. Question + ho

We now demonstrate how the proposed analysis can account for the patterns with questions embedded by ho. Consider (29), repeated from (9):

(29) Bingo sik haa ne ho?
    who eat shrimp WHQ HO
    ‘Who eats shrimp? Do you share the same question?’

Based on our assumption that ne lexically encodes quest, we translate the question in (9) as follows:

\[
(30) \quad c + ho(\text{quest}([\text{who eat shrimp}]))_{w,s,a} =
\]

\[
\left\langle \begin{array}{l}
\text{cs}, \text{push} \left\{ \begin{array}{l}
\text{cs} \cap \{w' \mid \text{quest}_{w',a}([\text{who eats shrimp}]) \text{ is defined in } w' \}, \\
\text{cs} \cap \{w' \mid \text{quest}_{w',a}([\text{who eats shrimp}]) \text{ is undefined in } w' \}
\end{array} \right\}, \mathcal{T}_c \end{array} \right\rangle
\]

defined only if \( \text{quest}_{w,s,a}([\text{who eats shrimp}]) \) is defined in \( w \)

Accordingly, the result of uttering (9) is to push onto \( \mathcal{T}_c \) the issue of whether or not the addressee \( a \) can felicitously ask the embedded question who eats shrimp. It comes packaged with the felicity condition that the speaker \( s \) can ask the embedded question felicitously.

In the scenario where \( a \) can felicitously perform the question act, it entails that they are ignorant of the answer. In this scenario, \( a \) may choose an answer like (31a), repeated from (14a), to indicate that the question act is defined for them. Alternatively, in a scenario where \( a \) cannot felicitously perform the question act, it entails just the opposite, namely, that they know the answer to the question. If this is indeed the case, then \( a \) may choose to answer the embedded question with something like (31b), repeated from (14b).

(31) a. Hai lo.
    yes SFP
    ‘Yes.’

b. Aaman lo.
    Aaman SFP
    ‘Aaman.’

Another way for the addressee to indicate that she may felicitously perform a question act is to acknowledge that she is also ignorant about the answer to the question, just like the speaker is. In this case, an answer like (32a), repeated from (14c), may be used and has the same effect as (31a). However, due to the binary nature of the choice, the addressee will never be ignorant about her ability to perform such a question act. In other words, the addressee either can ask the question or cannot ask the question. For this reason, an answer like (32b), which lacks the additive particle dou and hence indicates ignorance towards the matrix question, is judged to be infelicitous.
The present analysis can also capture the felicity of Q-ho questions. As described in section 2.3, a Q-ho question is appropriate when the speaker does not expect the addressee to know the answer to the question embedded by ho. The relevant example is repeated below:

**Scenario:** A famous scientist gave a talk on astrophysics. A, as a linguist, could not follow the talk. A’s friend B was a poet, and it seemed to A that B did not understand the talk either (see Figure 1).

(33) Keoi gong me ne ho?
he say what WHQ HO
‘What did he say? Do you share the same question?’

(34) #Keoi gong me ne?
he say what WHQ
‘What did he say?’

In the scenario, the ho-Q question, rather than the ordinary wh-question, is more felicitous. According to Farkas and Bruce (2009), the context state following an ordinary question is inquisitive with respect to the denotation of the sentence radical that is pushed onto $T_c$. For example, uttering (34) indicates that the speaker would like to update the context in one of the relevant ways, i.e., intersecting $cs_c$ with different propositions contained in the set denoted by *what did he say*, but s/he is not sure which update matches the fact in the actual world. Therefore, in order to successfully update the context, the speaker expects the addressee to pick out one of the possible updates. In other words, the addressee is expected to provide an answer to the question. However, the given scenario implies that the speaker does not believe the addressee knows the answer. As a result, asking (34) is not felicitous.

By contrast, the speaker’s inquiry is transformed when the question is embedded under ho, as in (33). According to the definition of ho, this question can be translated as:

(35) $c + ho(quest([what did he say]))_{w,s,a} =$

\[
\left\langle cs_c, push\left(\begin{array}{l}
\{cs_c \cap \{w' \mid quest_{w',a}([what did he say]) \text{ is defined in } w'\}\}, T_c\} \right)
\end{array}\right\rangle
\]

\text{defined only if } quest_{w,s}(\{what did he say\}) \text{ is defined in } w

In this case, the speaker intends to update the context with one of the two possible mental states of the addressee’s: either the addressee can ask *what did he say* or s/he cannot. The former entails the addressee’s ignorance towards the question, while the latter entails the addressee’s knowledge regarding the question. Therefore, the speaker does not need to expect the addressee to know the answer to the embedded question. In fact, if the speaker does have such a belief, she would use (34) instead of (33).
4. Other question particles

So far, we have discussed the question particle *ne*, and its interaction with *ho*. As mentioned in section 2.1, Cantonese has other question particles. For example, to indicate a polar question, the polar question particle *maa* may be used (36). There is also a particle *aa*, which can be used in wh-questions and alternative questions (37).

(36) Aaman sik haa maa?
Aaman eat shrimp POLQ
‘Does Aaman eat shrimp?’

Polar question particle *maa*

(37) Lei-go hai mei jisi aa?
this-Cl is what mean AA
‘What does this mean?’

Wh/Alternative-question particle *aa*

What is interesting about these particles is that a special context is required to use the questions resulting from stacking them under *ho*, or else a pragmatically marked flavor arises. The natural context to use questions like (38a) and (38b) is a ‘switch addressee’ context. In such a context, the question embedded by *ho* is directed to an addressee but the whole *ho*-question is directed to a different addressee. If not used in such a context, (38a) and (38b) are very marked, and almost seem like an indirect and somewhat pretentious way to get the addressee to provide an answer to the embedded question. In this paper, we do not formally deal with the ‘switch addressee’ context (but see footnote 12 for an informal discussion). However, we would like to suggest a way to derive the markedness of these questions when they are not used in a ‘switch addressee’ context.

(38) a. *maa* + *ho*
Aaman sik haa maa ho?
Aaman eat shrimp POLQ HO
‘Does Aaman eat shrimp? Do you share the same question?’
Marked: addressed to the same addressee
Unmarked: addressed to different addressees

b. *aa* + *ho*
Bingo sik haa aa ho?
who eat shrimp AA HO
‘Who eats shrimp? Do you share the same question?’
Marked: addressed to the same addressee
Unmarked: addressed to different addressees

A related observation is that *maa* and *aa* may not be used when there is no addressee at all, but *ne* is

---

11This question is acceptable when the embedded question is used rhetorically. A related observation, due to Lam (2014), is that *ho* may stack on the biased polar question particle *me*. We leave rhetorical questions feeding *ho* for future studies.
fine in such a context. We take this to suggest that \( maa \) and \( aa \) have an additional felicity condition requiring the obligatory presence of an addressee who is expected to answer the question. It is this additional felicity condition that gives rise to the pragmatic flavor. To see this, let us define the \texttt{quest} operator corresponding to \( aa \) (\( maa \) can be defined in a similar manner). It is identical to \( ne \) except for an extra felicity condition in (b).

\[
(39) \quad c + \texttt{quest}^{aa}_{w,s,a,c}(Q) = \langle \texttt{cs} \cdot \texttt{push}(\{ \texttt{cs}_c \cap \{ w' \mid p(w') \} \mid p \in Q \}, T_c) \rangle, \text{defined only if}
\begin{align*}
& a. \texttt{s}_c \text{ does not know the answer to } Q \text{ in } w \\
& b. \texttt{s}_c \text{ believes that } \texttt{a}_c \text{ can answer } Q \text{ in } w
\end{align*}
\]

\texttt{quest}^{aa} leads to the same inquisitive context as \texttt{quest}^{ne} does, but it has one more felicity condition—the speaker believes that the addressee knows the answer to the embedded question. Accordingly, using an \( aa \)-question is only appropriate if the question is directed to a person that the speaker thinks is able to resolve the question. As a result, an \( aa \)-question can never be self-directed.

Combining an \( aa \)-question with \( ho \) results in an odd question. Take (38b) as an example. The denotation of this sentence is represented as (40).

\[
(40) \quad c + ho(\texttt{quest}^{aa}(\llbracket \text{who eats shrimp} \rrbracket)) = \\
\left( \texttt{cs}_c \cdot \texttt{push} \left( \begin{array}{c}
\texttt{cs}_c \cap \{ w' \mid \texttt{quest}^{aa}_{w,s,a,c}(\llbracket \text{who eats shrimp} \rrbracket) \text{ is defined in } w' \}, \\
\texttt{cs}_c \cap \{ w' \mid \texttt{quest}^{aa}_{w,s,a,c}(\llbracket \text{who eats shrimp} \rrbracket) \text{ is undefined in } w' \}
\end{array} \right), T_c \right)
\]

defined only if \( \texttt{quest}^{aa}_{w,s,a,c}(\llbracket \text{who eats shrimp} \rrbracket) \) is defined in \( w \)

(40) updates the context by pushing onto \( T_c \) a question that can be paraphrased as: \textit{can the addressee }\texttt{a}_c\textit{ perform the }\texttt{aa}-\textit{question felicitously or not.} We argue that the addressee would never pick the positive member in the set, because the positive member represents a set of felicity conditions that contradict the felicity conditions of accepting (40). Suppose to the contrary that (40) is accepted and \( \texttt{a}_c \) picks the positive member, namely, that it is defined for \( \texttt{a}_c \) to perform the \( aa\)-question. What this implies is that \( \texttt{a}_c \) is ignorant of the answer to the question \texttt{who eats shrimp} and believes that their addressee (i.e., the speaker \( \texttt{s}_c \)) can provide the answer. This gives rise to a contradiction. The whole update characterized by (40) is defined only if \( \texttt{s}_c \) is ignorant of the answer to \texttt{who eats shrimp} and expects \( \texttt{a}_c \) to provide the answer. So, \( \texttt{a}_c \) cannot reasonably believe that \( \texttt{s}_c \) can provide the answer to the \( aa\)-question, prohibiting \( \texttt{a}_c \) from picking the positive member.\footnote{In a ‘switch-addressee’ context, the additional felicity condition is not problematic because the speaker now only believes that the addressee of the embedded \( aa\)-question can provide an answer to the question. As a consequence, for the addressee of the \( ho\)-question to felicitously ask the \( aa\)-question, they only need to believe that the addressee of the embedded question, which is no longer the speaker, knows the answer to the \( aa\)-question. We have to leave the discussion of the ‘switch-addressee’ context informal primarily due to the lack of space for developing a mechanism for changing the addressee parameter of a speech act operator.}
Since one of the proposed updates in (40) is defunct and will never be picked by the addressee, the ho-question is not a well-defined inquisitive update. Rather, it bears a pragmatic effect similar to that of a rhetorical question, namely, only one of the proposed updates is consistent with the context. In this case, the only plausible update is that asking the same aa-question is undefined for the addressee.

If we unpack what it means for the addressee to pick the undefined option, we will see why the whole ho-question is often used to coax the addressee into actually answering the embedded aa-question. First, the addressee cannot felicitously ask the aa-question for an obvious reason, namely, that their addressee (i.e., the speaker of (40)) cannot provide an answer to the question. It is not informative for the speaker. This is because if a speaker utters (40), he has already indicated that he does not know the answer to the embedded aa-question.

Second, if the addressee knows how to answer the aa-question, it is also infelicitous for them to use this question. In this case, assuming a cooperative conversational partner, the speaker expects the addressee to answer the aa-question directly. As a result, the speaker can use the aa-ho-question as an indirect way to elicit an answer to the embedded aa-question.

5. Conclusion

This paper pursued the claim that the grammatical embeddability of speech act operators under higher operators is based on a system of compositional semantics at the speech act level. Basing the discussion on Cantonese ho, we argued that ho operates on speech acts and returns a higher level speech act that has the effect of asking the addressee if they would like to perform the same speech act as the speaker. The contribution of this particle is modeled in an update semantics, whereby speech act operators have two components: an overt instruction regarding how to update the input context, as well as a mechanism of checking whether the speech act is felicitously performed. In future research, we seek to uncover such particles in other languages with a rich inventory of sentence-final particles, as well as to extend the speech act embedding mechanism developed here to account for other speech act phenomena.

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Dordrecht.
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Distinguishing coercion and underspecification in Type Composition Logic

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Abstract. This paper investigates the meaning adaptability of change of state (CoS) verbs. It argues that both coercion and underspecification are necessary mechanisms in order to properly account for the semantic adaptability observable for CoS verbs in combination with their complements. This type of meaning adaptability has received little formal attention to date, although some recent work has already led the way on this topic (Spalek, 2014; Lukassek and Spalek, 2016; Asher et al., 2017). Our paper is part of a cross-linguistic case study of German 

einfrieren

and Spanish 

congelar

(‘freeze’). We model the meaning adaptability of this test case within Type Composition Logic (TCL) (Asher, 2011). We build on Asher’s coercion mechanism and introduce an additional mechanism for underspecification that exploits the fine-grained type system in TCL.

Keywords: lexical semantics, change of state verbs, coercion, underspecification, Type Composition Logic.

1. Introduction

The verbs 

einfrieren

in German and 

congelar

(‘freeze’) refer to physical ((1a) and (1b)) and abstract ((2a) and (2b)) change of state events, as illustrated in the following examples.3

(1) a. Ida fror die Suppe ein. (physical event)
   Ida froze the soup in
   ‘Ida froze the soup.’
   b. Ida congeló la sopa.
   Ida froze the soup
   ‘Ida froze the soup.’

(2) a. Die Gewerkschaft fror die Verhandlungen ein. (abstract event)
   the union froze the negotiations in
   ‘The union froze the negotiations.’

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2For the purposes of this paper we will stick to German and Spanish as languages of investigation, but will illustrate our points using mainly German data. Based on the Spanish data analysed in Spalek (2014), we assume that, except for some minor differences, 

einfrieren

and 

congelar

display comparable behaviour.

3German examples are from Das Deutsche Referenzkorpus (DeReKo) at the Institut für Deutsche Sprache, Mannheim, available at http://www.ids-mannheim.de/kl/projekte/korpora/. Examples with no indication of the source have been constructed by us.
b. El sindicato congeló las negociaciones.
   The union froze the negotiations
   ‘The union froze the negotiations.’

The wide spectrum of events referred to by einfrieren and congelar is not exclusive to German or Spanish, but rather represents a general pattern to be found in many other languages, such as, for instance, English and Polish. We will discuss how this phenomenon is to be modelled and will argue for an underspecification mechanism that generates the two basic readings from one common lexical entry. In our account, we will understand underspecification as a free combinatorial choice that is lexically anchored. In addition to these free combinatorial choices, einfrieren (‘freeze’) also naturally appears in coercion contexts. These contexts involve a compositional clash between the verb and its complement that can be repaired. This combinatorial option has been discussed for the physical reading in English in Asher (2011). For German, an example like (3a) involves a reinterpretation from a container to its content. (3b), in turn, is an example of such a coercion context in the abstract reading. The state-denoting argument Punktestand ‘scores’ is reinterpreted as a development in scores and this development can be frozen.

(3) a. Ida hat die Flasche eingefroren.
   Ida has the bottle in-frozen
   ‘Ida froze the bottle.’

b. d. h. der Punktestand wird eingefroren...
   that means the score is in-frozen
   ‘that means that the score is being frozen...’
   (https://goo.gl/Mnv17X)

Throughout this paper, we address what characterizes the different readings of einfrieren and congelar, how their multiple meanings correlate with the semantics of their complements and what theoretical status should be assigned to the multiple readings of the verb. These questions help disentangle cases of coercion from cases of underspecification. Formally, we understand underspecification as a lexically anchored dependent type whose specification hinges on the type of a parameter contributed by the complement’s type. Coercion, in turn, arises from a combinatorial conflict that triggers a repair mechanism licensed by a lexical polymorphic type in the verb introducing a suitable variable.

We proceed by first providing a description of the possible readings of einfrieren and congelar, taking into account the conceptual content as well as the lexical aspectual properties. Following this, we present more data concerning the combinatorial patterns of einfrieren and congelar. Finally, we provide a semantics for einfrieren/congelar by implementing the observations in Type Composition Logic (TCL) (Asher, 2011).
2. Distinguishing the two readings of einfrieren

Change of state (CoS) verbs are generally ambiguous between referring to physical and abstract events, as already observed for Spanish by Spalek (2014). The reading systematically depends on the type of the internal argument.

(4) a. Die Vase / die Beziehung zerbrach.
the vase / the relationship broke
‘The vase / the relationship broke.’
b. Der Bürgermeister schnitt den Faden / die Stromversorgung ab.
the mayor cut the cord / the electricity supply off
‘The mayor cut off the cord / the electricity supply.’
c. Das SEK hat eine Scheibe / einen Schmuggelring zerschlagen.
the SEK has a window / a trafficking ring through-smashed
‘The special law enforcement unit has smashed a window / a trafficking ring.’

In order to tease apart the different readings of einfrieren, we need to take a closer look at the factors that influence the different readings. In the following, we will first examine the conceptual content contributed by the verb and, second, focus on its aspectual properties in each reading.

Firstly, einfrieren can describe conceptually different contents that bring about different result states. The physical reading denotes an event of change in temperature and consistency of the complement with the effect of making the complement non-perishable (5a). These properties, however, do not hold for the result state brought about by the abstract event einfrieren, as illustrated in (5b).

(5) a. Emil fror die Suppe ein. Sie war danach kalt, steinhart und haltbar.
Emil froze the soup in she was afterwards cold, rock-hard and non-perishable
‘Emil froze the soup. Afterwards it was cold, rock-hard and non-perishable.’
b. #Die Gewerkschaft fror die Verhandlungen ein. Sie waren danach kalt,
the union froze the negotiations in they were afterwards cold
steinhart und haltbar.
rock-hard and non-perishable.
‘The union froze the negotiations. Afterwards they were cold, rock-hard and non-perishable.’

The abstract reading, in turn, denotes an event of ‘interruption’. The result state brought about by abstract einfrieren amounts to the complement event not taking place anymore, (6a). This result state does not arise in the physical reading, (6b).

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4 An analogous observation has been made by Asher et al. (2017: p. 137, (3)), who give possible contextual specifications for English swallow and run.

5 A question that is outside the scope of this paper concerns the kinds of causation that are involved in each of the readings: issues such as direct vs. indirect causation or intentionality. These factors cut across the distinction between physical and abstract readings. For more discussion on this topic, see Spalek (2014).
Die Gewerkschaft fror die Verhandlungen ein. Sie fanden danach nicht mehr statt. 'The union froze the negotiations. Afterwards they did not take place anymore.'

Emil fror die Suppe ein. Sie fand danach nicht mehr statt. 'Emil froze the soup. Afterwards it did not take place anymore.'

Abstract *einfrieren* has the same entailment pattern as *unterbrechen* ‘interrupt’. Engerer (2014) (following ideas from Dowty, 1979) shows that aspectual verbs can be accounted for in terms of a common pattern of presuppositions and entailments displayed for *interrupt* in (7). According to these, *einfrieren* falls into the egressive class, like *unterbrechen*.

Die Gewerkschaft hat die Verhandlungen eingefroren / unterbrochen. 'The union froze the negotiations.'

The two readings can be combined with two different types of modifiers. Instruments are only compatible with the physical reading, as the contrast between (8a) and (8b) illustrates, whereas only eventive *mit*-PPs can modify abstract readings of *einfrieren*, as shown in the contrast of (9a) and (9b). The fact that eventive *mit*-modifiers are only compatible with the abstract reading is due to the fact that these modifiers are generally restricted to events that are more abstract than the modifier event itself. They add a concrete conceptualization to their target, as observed by Lukassek (2015).

Ida fror die Suppe mit Flüssigstickstoff ein. 'Ida froze the soup with liquid nitrogen.'

Die Gewerkschaft fror die Verhandlungen #mit dem Telefon ein. 'The union froze the negotiations with the telephone.'

Die Gewerkschaft fror die Verhandlungen mit einem Telefonanruf / mit einer Pressekonferenz ein. 'The union froze the negotiations with a call / with a press conference.'

Emil fror die Suppe #mit dem Ablegen im Gefrierfach ein. 'Emil froze the soup by depositing it in the freezer.'

Physical readings of *einfrieren* allow embedding under perception verbs (10a), since physical events can easily be perceived by our senses. This is not natural for abstract *einfrieren*-events,
The observations made so far thus clearly show that abstract **einfrieren** readings represent overall more abstract events than the physical **einfrieren**-events. Clear differences are also to be observed concerning lexical aspect. Earlier studies have classified English **freeze**, the equivalent of German **einfrieren**, as a prototypical CoS verb (Levin, 1993; Levin and Rappaport Hovav, 1995; Wright, 2002; Koontz-Garboden, 2009). When applying classic aspectual diagnostics (Dowty, 1979), both readings of **einfrieren**, physical and abstract, are telic, and yet they differ with respect to Aktionsart, as the following tests illustrate: only the physical reading (11a) is compatible with interval adverbials, such as *in zwei Stunden* ‘in two hours’.

(11) a. Ida fror die Suppe in zwei Stunden ein.
Ida froze the soup in two hours in
‘Ida froze the soup in two hours.’

b. Die Gewerkschaft fror die Verhandlungen in zwei Stunden ein.
the union froze the negotiations in two hours in
‘The union froze the negotiations in two hours.’

Only the physical reading (12a) can be embedded under the aspectual verb **aufhören** ‘stop’, since only this fulfills the requirement of having a temporal extension, whereas abstract **einfrieren**-events lack temporal extensions (12b).

(12) a. Emil hörte auf, die Suppe einzufrieren, weil er doch Lust hatte, sie sofort zu essen.
Emil stopped up the soup to freeze, because he after all desire had it immediately to eat
‘Emil stopped freezing the soup, because after all he wanted to eat it immediately.’

b. Die Gewerkschaft hörte auf, die Verhandlungen einzufrieren, weil der Vorstand doch einlenkte.
the union stopped up the negotiations to freeze, because the board after all gave in
‘The union stopped freezing the negotiations, because the board gave in after all.’

The adverb **fast** ‘almost’ differs in the way it can take scope over the different readings of **einfrieren**. Assuming Dowty’s structure of accomplishments, in the physical reading (13a) **fast** can scope either over the CAUSE-component or over the BECOME of the CoS, entailing that either

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6See Spalek (2014) for Spanish **congelar**.
Ida did not act at all or the soup did not freeze completely, respectively. The abstract reading of *einfrieren* (13b) displays a typical achievement behaviour with *fast* ‘almost’ conveying that the event actually did not take place and no other reading is possible.

(13)  

a. Ida fror die Suppe fast ein. (2 readings)  
Ida froze the soup almost in  
‘Ida almost froze the soup.’  

b. Die Gewerkschaft fror die Verhandlungen fast ein. (1 reading)  
the union froze the negotiations almost in  
‘The union almost froze the negotiations.’

The abstract reading is furthermore hard to get in the progressive form, as the contrast in (14) illustrates.

(14)  

a. Ida war am die Suppe einfrieren.  
Ida was on the soup in-freezing  
‘Ida was freezing the soup.’  

b. ?Die Gewerkschaft war am die Verhandlungen einfrieren.  
the union was on the negotiations in-freezing  
‘The union was freezing the negotiations.’

The tests above clearly illustrate that the abstract reading of *einfrieren* patterns together with achievements, whereas the physical reading patterns together with accomplishments. We conclude this section with the observation that the conceptual and aspectual differences are good reasons to consider the two readings as discrete. We will now turn to a more detailed analysis of the combinatorial patterns of *einfrieren* and *congelar*.

3. Meaning contribution of the complements

In Spalek (2014), we find a detailed description of *congelar* that clearly illustrates how the complement plays a crucial role in specifying the interpretation of the verb and what can be considered compositional clashes. In this section, we provide a detailed analysis of the combinatorics of *einfrieren* for each reading. In addition, we discuss possible lexical meanings for the two readings of *einfrieren* to be spelled out in TCL.

3.1. Physical readings

Asher (2011: 9.3) discusses two types of physical readings of English *freeze*. First, he describes the compositional variant that is covered by the selectional restriction LIQUID for the internal argument. This selectional restriction effectively accounts for the physical cases discussed so far. Second, he identifies a coercion reading (15) that is based on a coercion from a container to its content. The container-type noun *bottle* does not satisfy the selectional restriction LIQUID that

German does not have a regular progressive. However, the dialectal *Rheinische Verlaufsform* corresponds to the English progressive and is standardly applied as an aspectual test.
freeze imposes and thus a compositional conflict arises.

(15) The bottle froze.
The liquid in the bottle froze.
(Asher, 2011: p. 248, (9.12a))

This conflict, however, can be resolved by introducing an argument of suitable type. More precisely, within Asher’s TCL, coercions have a lexical anchor insofar as compositional conflicts can be resolved via lexically encoded dependent types. The verb freeze, for instance, features a dependent type that takes a CONTAINER-type argument and yields an argument of LIQUID-type that is the content of the container. According to Asher, freeze is just one of many examples that strengthens the argument for understanding coercion as a lexically based operation.

Yet, even the restriction to liquids on the one hand and an option for coercion on the other are still too limited to account for the possible combinations in the physical domain, and examples such as in (16) and (17) prove that German einfrieren combines with all sorts of physical objects, e.g. Spargel ‘asparagus’ or Hagelkorn ‘hailstone’, that do not justify the type presupposition LIQUID. Furthermore, none of these cases plausibly involves a coercion from a container to its content.

(16) Kann man Spargel eigentlich auch einfrieren?
can one asparagus actually also in-freeze
‘Is it actually possible to freeze asparagus?’
(Im Wohnzimmer lauert das Grauen, Süddeutsche Zeitung, 22.07.2011)

(17) Jay Lawrimore ... lobte die schnelle Reaktion der Bewohner Auroras, die das
Jay Lawrimore praised the quick reaction of the inhabitants of Aurora who the
überdimensionale Hagelkorn eingesammelt und eingefroren hatten.
oversized hailstone collected and in-froze had
‘Jay Lawrimore, the head of the committee, praised the quick reaction of the inhabitants
of Aurora, who had collected and frozen the colossal hailstone.’
(Das grösste Hagelkorn war fast so groß wie ein Handball, spektrumdirekt, 05.08.2003)

Asher’s proposal thus only covers a part of the combinatory potential that the physical reading of einfrieren actually displays. The two examples indicate that the selectional restriction on the internal argument is more liberal than anticipated and has to be opened to all physical objects. Thus, the mere change from a liquid to a solid state of a substance cannot be an exhaustive description of the physical reading of einfrieren. In fact, the examples discussed so far suggest that the result state of the physical reading comes in three different manifestations: 1) with liquids, like soup, the relevant change of state amounts to the physical object changing from a liquid to a solid state, 2) with solid objects, like asparagus, freezing mainly involves a reduction in their temperature, and 3) with atmospherically fragile solid objects, like hailstones, freezing essentially denotes preservation, e.g. by making sure their temperature stays below zero. We can thus conclude that for the result state of the physical reading, three component predicates have to hold of the complement, cf. (18). If a soup is frozen, its temperature is below zero, it is solid,
and it is preserved. The same holds for asparagus and hailstone.

\begin{equation}
\text{frozen}_p(x) = \text{temperature}(x) < 0 \land \text{solid}(x) \land \text{preserved}(x).
\end{equation}

Whereas the result state is identical in all three cases, the change of state that leads to the result differs. It might involve the change of one or more component predicates of the result. This means that the presupposition about the state of the complement before the reference time is underspecified. At least one of the three components does not apply at the time before the result state holds. Which of the components is targeted depends on the specific type of the complement.

Further, Asher’s proposal for the second reading, which involves container-content-coercions, has a shortcoming too. In his account, this type of coercion is licensed by a dependent type that is anchored in the lexical semantics of freeze. His proposal predicts that the container-content-coercion is an idiosyncrasy of freeze. However, this type of coercion appears to be very systematic and ranges over distinct verb classes, as the examples in (19) to (21) prove: all these verbs select for liquids and in all cases a container complement is acceptable. In much earlier work, Apresjan (1974) already pointed out that the container-content-metonymy is a regular polysemic pattern that can be found in many contexts.

\begin{itemize}
  \item (19) Emil hat die ganze Flasche / Tasse getrunken. \\
  \hspace{1cm} Emil has the whole bottle / cup drunk \\
  \hspace{1cm} ‘Emil has drunk the whole bottle / cup.’
  \item (20) Er hat die Flasche / das Glas verschüttet. \\
  \hspace{1cm} he has the bottle / the glass spilled \\
  \hspace{1cm} ‘He has spilled the bottle / the glass.’
  \item (21) Die Männer ließen sich noch eine weitere Flasche durch die Kehle laufen. \\
  \hspace{1cm} the men let self still a next bottle through the throat run \\
  \hspace{1cm} ‘The men swallowed yet another bottle.’
\end{itemize}

If we take Asher’s endeavour to clarify the role of the lexicon in coercive operations seriously, the potential for a container-content-coercion cannot be part of the lexical entry of einfrieren. Rather, the interpretation of (15) has to be explained on independent grounds that lie outside of the scope of this paper, as they do not concern the lexical semantics of einfrieren per se.

Based on the discussion so far, we propose the lexical semantics for the physical interpretation of einfrieren in TCL-style\(^8\) in (22). Three features are central here. First, the result state of einfrieren is decomposed into the components solid, temperature below zero and preserved. We use FROZEN as a type label for these three components. Second, einfrieren selects an internal

\(^8\)In TCL, meaning representations consist of two levels. The external semantics is a regular \(\lambda\) term with a standard model-theoretic interpretation. The internal semantics features rich typing information on the variables of the term. It has a proof-theoretic interpretation. Both layers are integrated into one linear representation. The internal semantics is managed via an additional argument \(\pi\) that stores and passes all typing information throughout the composition. Type information is concatenated by the operator \(\ast\).
argument of type P, i.e. a physical object. Third, contrary to Asher’s proposal, the physical reading of einfrieren does not feature a polymorphic type that could license a container-content-coercion.

(22) \[ \text{einfrieren}_p = \lambda \Psi \lambda \Phi \lambda e \lambda \pi \exists s . \Phi(\pi)(\lambda x \lambda \pi_1 . \Psi(\pi_1 * \text{ARG}_3^{\text{freeze}} : P)(\lambda y \lambda \pi_2 . \text{freeze}'(e, x, y, \pi_2 * \text{ARG}_1^{\text{freeze}} : \text{BECOME}) \land \text{result'}(s, e, \pi_2 * \text{ARG}_1^{\text{result}} : \text{FROZEN}))) \]

In the physical reading (22), einfrieren takes two generalized quantifiers, \( \Psi \) (the internal argument) and \( \Phi \) (the external argument), and an event variable \( e \) as arguments and introduces a resultant state \( s \) that is existentially bound. On the type level, einfrieren passes the type requirement \( P \) to its complement. The referential argument \( e \) is typed as \( \text{BECOME} \) and the result state \( s \) is of \( \text{FROZEN} \)-type. On the term level, einfrieren contributes a freeze’-predicate with the referential argument \( e \), the internal argument \( y \) and external argument \( x \). The result state \( s \) is related to the event \( e \) via the result’-predicate. The meaning computation for sentence (23) is given in (24). This will give us a first impression of how the compositional apparatus works.

(23) Das Mädel for deen Tee ein.
‘The girl froze the tea.’

In (24a), einfrieren is applied to the internal argument DP den Tee. The internal argument has a standard generalized quantifier representation. It is typed as LIQUID. This typing information stems from the lexical typing of the noun Tee. The predicate selects for a physical object in this position. This type presupposition is passed onto the complement via the \( \pi \)-parameter, which is applied to the \( \pi \)-parameter within the complement DP. As liquids are subtypes of physical objects, functional application is possible and the composition proceeds. In (24b), the subject DP is integrated. As the combinatorics with the subject is of no concern here, we do not specify the type information on this argument in the interest of readability. After the subject has been integrated, the referential argument is existentially closed and type presuppositions are bound (24c).

(24) a. \[ \text{einfrieren}[[\text{den Tee}]] = \]
\[ [\lambda \Psi \lambda \Phi \lambda e \lambda \pi \exists s . \Phi(\pi)(\lambda x \lambda \pi_1 . \Psi(\pi_1 * \text{ARG}_3^{\text{freeze}} : P)(\lambda y \lambda \pi_2 . \text{freeze}'(e, x, y, \pi_2 * \text{ARG}_1^{\text{freeze}} : \text{BECOME}) \land \text{result'}(s, e, \pi_2 * \text{ARG}_1^{\text{result}} : \text{FROZEN})))]
\]

b. \[ \text{den Tee einfrieren}[[\text{das Mädchen}]] = \]
\[ [\lambda \Phi \lambda e \lambda \pi \exists s . \Phi(\pi)(\lambda x \lambda \pi_1 . \exists ! t . \text{tea}'(t, \pi_1 * \text{ARG}_1^{\text{tea}} : \text{LIQUID}) \land \text{freeze'}(e, x, t, \pi_1 * \text{ARG}_1^{\text{freeze}} : \text{BECOME}) \land \text{result'}(s, e, \pi_1 * \text{ARG}_1^{\text{result}} : \text{FROZEN})))]
\]
c. **Existential closure of e and binding presuppositions:**

$$
\lambda \pi \exists ! g \exists ! t : \text{LIQUID} \exists e : \text{BECOME} \exists s : \text{FROZEN} \cdot \text{girl}'(g, \pi) \land \text{tea}'(t, \pi) \land \text{freeze}'(e, g, t, \pi) \land \text{result}'(s, e, \pi)
$$

When all arguments are integrated, the type presuppositions on the variables can be bound. This yields the meaning representation in (24c) for (23). There is exactly one \( g \), exactly one \( t \) of type LIQUID, an event \( e \) of type BECOME and a state \( s \) of type FROZEN such that \( e \) is a freezing event where the girl \( g \) freezes the tea \( t \) and \( s \) is the result of \( e \).

### 3.2. Abstract readings

We have seen that the parallelism of the abstract reading of *einfrieren* to aspectual verbs like *interrupt*, German ‘unterbrechen’, is well motivated by the common entailment patterns in (7). Similarly, both *unterbrechen* and *einfrieren* combine with events that have a temporal extension (activities and accomplishments) while excluding states (25c) and achievements (25d).

the union has the talks interrupted / in-frozen
‘The union has interrupted / frozen the talks.’

b. Die Regierung hat den Straßenbau unterbrochen / eingefroren.
the government has the road construction interrupted / in-frozen
‘The government has interrupted / frozen the road construction.’

the hair dresser has the beautiful be interrupted / in-frozen
‘The hair dresser has interrupted / frozen being beautiful.’

Mr Schmidt has the arriving of the train interrupted / in-frozen
‘Mr Schmidt has interrupted / frozen the arriving of the train.’

These tests show that an eventive selectional restriction overgenerates, because *einfrieren*, like *unterbrechen*, only selects for temporally extended events in its complement position. We use the type label TRANSITION for these two Aktionsarten. German corpus data mirrors this generalization, because most of the complements we found were events with a temporal extension such as *Siedlungstätigkeit* and *Friedensprozess*. Formally, we model these combinatorial cases as standard compositions via functional application.

(26) ... wenn Israel seine Siedlungstätigkeit einfriere.
... if Israel its settlement activity freezes
‘... if Israel stops the settlement politics.’

(*Israel räumt Teil der Siedlungen, Die Presse, 14.10.1999*)
‘Freezing the peace process inhibits the foundation of a Palestinian state.’

(27) Wenn man den Friedensprozess einfriert, verhindert man die Gründung eines palästinensischen Staates.

‘Freezing the peace process inhibits the foundation of a Palestinian state.’

(Früchte des Zorns, Süddeutsche Zeitung, 27.10.2004)

However, corpus data from Spanish (Spalek, 2014) and German show that the combinatorial patterns are still more diverse. Value-denoting nouns, such as Eintrittspreise (28), abound in both languages. The interpretation of this example involves the inhibition of an increase in the prices.

(28) Bei so viel Preisstabilität in der Branche hat auch die Düsseldorfer Messe ihre Eintrittspreise zum dritten Mal eingefroren.

‘Given the prices are stable in the branch, the Düsseldorf trade fair has frozen its entry prices for the third time.’

(Bei der weltgrößten Wassersportmesse “boot ’91” können sich 400000 Interessenten auf 1800 Boote freuen, Nürnberger Nachrichten, 15.01.1991)

Example (28) with the value-denoting noun Eintrittspreise ‘entry prices’ also falls into the compositional class. Following Löbner (2015), we classify Eintrittspreise together with other value-denoting nouns such as temperature, which can receive a reading as a function from times to individual values. That is, it is inherent to values that they change over time. An indicator for the presence of this function is the fact that verbs like rising can be predicated over value-denoting nouns. Eintrittspreise and other value-denoting nouns we encountered with einfrieren also pass this test.9

A combinatorial pattern that does not straightforwardly fit the transition restriction is (29) with the state-denoting complement Punktestand.10 This might seem surprising given the tests in (25). Yet intuitively, the interpretation involves the inhibition of an expected change in the scores, in other words a transition.

(29) d. h. der Punktestand wird eingefroren...

that means the score is in-frozen

‘that means that the score is being frozen.’

(https://goo.gl/Mnv17X)

Interestingly, genuine Kimian states (Maienborn, 2005; Bücking, 2012), such as Schön-Sein, Ähneln and 60-Kilo-Wiegen in (30), are not appropriate complements of abstract einfrieren. The

9Note that we assume that value-denoting nouns actually have two readings: they can either denote a concrete value or a function from times to values. In TCL, this kind of ambiguity is encoded as a Dot-type; cf. the co-predication test The admission price is 20 Euros and rising every year.

10The German word Punktestand is overtly marked as a state by the second component of the compound. The English translation does not reflect that fact.
reason for the ungrammaticality is that a presupposition of an inherent change is incompatible with the sortal properties of Kimian states. They are abstract entities without internal structure and lack potential for change.\footnote{In contrast, tropes in the sense of Moltmann (2013) as inherently changing entities are acceptable complements of \textit{eingfrieren} (i).}

\begin{tabbing}
(30) \textbf{Man friert #das Schön-Sein / #das Ähneln / #das 60-Kilo-Wiegen ein.} \=\textit{One freezes the beautiful-being / the resembling / the 60-kg-weighing in}\textbf{.}
\end{tabbing}

We can thus formally assume that (29) involves a meaning enrichment through an interpolation of a transition based on \textit{Punkttestand}. What is interpolated here is the development of the scores over time. ‘Freezing the scores’ then means inhibiting any development in the value of the scores. We model this example as a coercion in TCL terms. This coercion is possible within well-defined boundaries: only Davidsonian States can be coerced into events. Abstract \textit{eingfrieren} thus displays a similar behaviour to aspectual verbs, which are well known for their eventive selectional restriction and their ability to license a coercion from complements of other types to events (Pustejovsky, 1995; Egg, 2003; Asher, 2011).

Now that the combinatorial options in the abstract reading have been clarified, we turn to the properties of the result state brought about by abstract \textit{eingfrieren}. In the previous subsection, we argued that the result state of the physical reading is tripartite and comprises the properties of having a temperature below zero, being solid and being preserved. Of these three properties, only one is not restricted to the physical domain, namely the property of being preserved. Both physical objects and states of affairs as part of a transition can be preserved. This property functions as a conceptual bridge from the physical to the abstract reading. The other two component parts of physical freezing are omitted in the abstract reading.

We now have all ingredients to propose a meaning representation for the abstract reading. Our proposal has three central features. First, abstract \textit{eingfrieren} requires its complement to be of type \textsc{transition}. Second, in this argument position, coercion is lexically licensed. In order to model this, we integrate a polymorphic $\tau_\rho$ type into the type presupposition for the complement. It licenses a coercion in complement position if the selectional restriction is not met. The basis for complement coercion is restricted. Abstract \textit{eingfrieren} determines that only states are a suitable type from which transitions can be interpolated. Third, the result state \textsc{frozen} corresponds to the property of being preserved in the abstract reading.

\begin{tabbing}
(31) \hspace{1cm} $[\text{eingfrieren}_a] = \lambda \Psi \lambda \Phi \lambda e \lambda \pi \exists s. \Phi(\pi)(\lambda x \lambda \pi_1. \Psi(\pi_1 \ast \text{ARG}_3^{\text{freeze} \cdot \text{transition}} - \tau_\rho(\text{HD}(\Psi) \subseteq \text{STATE}))(\lambda y \lambda \pi_2. \text{freezer}(e, x, y, \pi_2 \ast \text{ARG}_1^{\text{freeze} \cdot \text{become} \ast \text{ARG}_1^{\text{ty}_PS(\Psi)})} \land \text{result'}(s, e, \pi_2 \ast \text{ARG}_1^{\text{result} \cdot \text{frozen}}))$\textbf{.}
\end{tabbing}

Abstract \textit{eingfrieren} has the same external semantics as the physical reading. It takes two

\begin{tabbing}
(i) \hspace{1cm} \textbf{Man friert die Schönheit / die Ähnlichkeit / das Gewicht ein.} \=\textit{One freezes the beauty / the resemblance / the weight in}\textbf{.}
\end{tabbing}

Tropes are concrete property manifestations on a holder; cf. Moltmann (2013).
generalized quantifiers (Ψ and Φ) and an event argument e and introduces an existentially bound state argument s. It contributes a freeze’-predicate and a state that is the result of the freezing event. Abstract and physical readings differ only in their internal semantics. The complement is restricted to being of type TRANSITION. Furthermore, abstract einfrieren features a polymorphic type for coercions from states to transitions. The meaning computation for a compositional abstract reading thus follows the line of the physical variant in (24).

In (34), we give the meaning computation for the coercion-case in (32): einfrieren is applied to the state-denoting complement Punktestand, which does not satisfy the verb’s selectional restriction transition. In order to repair the conflict, the interpolation of a suitable argument is licensed by the polymorphic type τρ. The polymorphic type licenses coercion only if the given complement is of STATE type. This restriction is met by Punktestand and the coercion operation can proceed.

(32)  Der Organisator froz den Punktestand ein.
the organizers froze the score in
‘The organizers froze the score.’

In (34a), abstract einfrieren is applied to the DP den Punktestand ‘the score’, which has the referential variable c in our representation. This variable is typed as STATE. The required type for the third argument of freeze is transition. With this typing information, a conflict on the variable c arises. As abstract einfrieren features a polymorphic type, the type presupposition can be accommodated by interpolating a suitable argument of transition type. The coercion functor in (34b) is a deduction from the polymorphic type based on the TCL rule for type accommodations with polymorphic types, see (33).

(33)  Type Accommodation with Polymorphic Types (Asher, 2011: p. 225):
\[
\begin{align*}
\phi(v,\pi) & \quad \pi \text{ carries } \text{ARG}^p_i \delta(\alpha,\beta) \ast \text{ARG}^O_j \alpha/\beta \quad v \in \text{ARG}^p_i \cap \text{ARG}^O_j \\
\mathcal{D}(\lambda w\lambda \pi_1,\phi(w,\pi_1))(\pi)(v)
\end{align*}
\]

The functor introduces the variable e1 that is a transition depending on the score. This dependency is expressed by the type information on e1. It has to be of type τρ(SCORE), which is a very specific type of transition, namely one that is a transition of scores. Typically, coercion functors in TCL introduce an underspecified predicate φ that requires contextual specification. This predicate relates the newly introduced variable e1 to the original state argument c. The underspecification of the predicate gives us the possibility to determine a concrete transition in the given context.

In (34c), the result of the application of the coercion functor is given. The freeze’-predicate now has e1 as its third argument. This variable meets the type requirements on the complement of abstract einfrieren. Nevertheless, the original state variable c is still present in the meaning representation and it has kept its original type. That is, the score-DP itself is still intact. The conflict has been solved locally in the nuclear scope of the quantifier, which is characteristic for TCL-style coercions.12 In (34d), the subject argument is integrated via regular functional

12 Although Asher (2011) gives a series of reasons why coercion should be local, computationally the locality has to
application.

(34) a. $\llbracket\text{einfrieren}\rrbracket(\llbracket\text{den Punktestand}\rrbracket) = (\lambda \Psi \lambda \Phi \lambda e \lambda \pi \exists s. \Phi(\pi)(\lambda x \lambda \pi_1. ...)$ phenomena where the operation is not local and has to be lexically designated as global (B"ucking and Buscher, 2015).

b. Coercion functor:

$$\lambda P \lambda z \lambda \pi' \exists e_1. \tau P(\text{score}). P(\pi')(e_1) \land \phi_{\tau P(\text{score})}(e_1, ... , \pi')$$

c. Local conflict resolution via coercion functor:

$$\lambda \Phi e \lambda \pi' \exists e_1. \tau P(\text{score}). \Phi(\pi')(\lambda x \lambda \pi_1 \exists! e. \text{score'}(e, \pi_1) \land \text{freeze'}(e, x, e, \pi_1) \land \text{result'}(s, e, \pi_1 \text{ARG}^{\text{result}}\text{FROZEN})) \land \text{TRANSITION} \land \tau P(\text{score})$$

d. $\llbracket\text{den Punktestand einfrieren}\rrbracket(\llbracket\text{der Organisator}\rrbracket) = \lambda e \lambda \pi' \exists! c: \exists c \exists e_1. \tau P(\text{score}). \text{organizer'}(o, \pi) \land \text{score'}(c, \pi) \land \text{freeze'}(o, e, e, \pi, \text{ARG}^{\text{result}}\text{FROZEN}) \land \text{TRANSITION} \land \tau P(\text{score})$$

e. Existential closure of $e$ and binding presuppositions:

$$\lambda \pi' \exists o \exists! c: \exists e: \exists s: \exists e_1. \tau P(\text{score}). \text{organizer'}(o, \pi) \land \text{score'}(c, \pi) \land \text{freeze'}(o, e, e, \pi) \land \text{result'}(s, e, \pi) \land \phi_{\tau P(\text{score})}(e_1, ... , \pi)$$

In (34e), we give the final meaning representation for (32). There is exactly one $o$, exactly one $c$ of type $\text{STATE}$, an $e$ of type $\text{BECOME}$, an $s$ of type $\text{FROZEN}$ and an $e_1$ of a $\text{TRANSITION}$ type depending on scores such that the organizer $o$ freezes an underspecified transition $e_1$ that is related to the score $c$ and the $\text{FROZEN}$ type state $s$ is the result of $e$. The underspecified transition predicate $\phi_{\tau P(\text{score})}$ is still to be specified. The specification of this predicate hinges on contextual information, but is restricted to transitions that have scores as an argument. One specification for this transition could be an increase in the scores.

4. An integrated lexical semantics for physical and abstract readings

So far, we have developed two separate lexical entries for the physical and the abstract readings. In this section, we will discuss the pros and cons of a unified lexical semantics for both readings of $\text{einfrieren}$ and make a proposal for its implementation in TCL.

The discreteness of the two readings seems to be a good reason to argue for two independent
lexical entries for *einfrieren*: physical freezing means lowering the temperature and abstract freezing means interrupting an ongoing event. More precisely, we have observed that the two readings bring about different result states and belong to different aspectual classes. Whereas physical *einfrieren* is an accomplishment, abstract *einfrieren* patterns with achievements. With this in mind, the assumption of two independent lexical entries has some initial motivation. However, postulating two independent lexical entries for *einfrieren* would miss the conceptual relation between the two readings. Physical and abstract *einfrieren* share the conceptual core *PRESERVED*. This component represents the conceptual bridge that allows for the transfer from the physical domain to the abstract domain. Furthermore, this kind of ambiguity between physical and abstract change of state events is very systematic. We have seen that the ambiguity occurs with different CoS verbs, too. Moreover, it is parallel across languages; cf. Spanish *congelar*, English *freeze*, French *geler* and Polish *zamraźać/zamrozić*, to name just the languages we have intuitions for. We would disregard a systematic lexical pattern if we considered the ambiguity to be a case of homonymy. We take these observations to be arguments enough for a unified lexical semantics for both readings of *einfrieren*. This lexical entry has to be semantically adaptable to different types of argument input. The combination of the lexical semantics of the verb with the semantics of the complement will tell us which inferences to draw in each case.

Our proposal for a unified semantics of the CoS verb *einfrieren* builds on the common assumption that CoS verbs have the underlying class-specific lexical template *BECOME* and differ in the idiosyncratic result state.\(^{13}\) The unified lexical semantics for *einfrieren* is given in (35). It uses both a coercion and an underspecification mechanism. The two mechanisms have a lexical anchor in the internal semantics of *einfrieren*. Underspecification accounts for the dichotomy between physical and abstract readings, and we model it as a dependent type. Dependent types are complex types that are already envisaged within TCL. A type qualifies as a dependent type if it has another type as its parameter. We use a dependent *FROZEN*-type with the complement’s type as its parameter for the result state of *einfrieren*. This means that the actual type of the result state is assigned only upon combination with the complement. The type assignment is driven by the general type *FROZEN* in (35b). If the parameter is a physical object, *FROZEN* will be specified to the tripartite type \(\text{SOLID} \land \text{TEMP}<0 \land \text{PRESERVED}\). If the parameter is a transition, the general type *FROZEN* yields a specification to *PRESERVED*. These two parameter types are the only types that are lexically licensed. This is provided for by the type presupposition on the complement. It allows exclusively physical objects or transitions.

The combinatorial peculiarities we identified in the abstract reading are modelled along the lines proposed for coercion in Asher (2011). The lexical entry features a polymorphic type for the complement position. This polymorphic type comes into play in well-defined cases. If the overt complement does not justify the selectional restriction, the compositional conflict can be repaired if the overt argument is a state. The polymorphic type then licenses the interpolation of a *TRANSITION* type argument. This newly introduced argument justifies the selected *TRANSITION* type in the complement position. The coercion operation is lexically determined to be local and non-destructive, i.e. the conflict resolution does not change the type of the complement DP itself.

\(^{13}\)We represent the CoS via the type *BECOME* for the referential argument. *BECOME* is underspecified with regard to the exact aspectual class; see Dowty (1979).
[(35)  a. \[\text{[einfrieren]} = \lambda \Psi \lambda \Phi \lambda e \lambda \pi \exists s. \Phi(\pi)(\lambda x \lambda \pi_1. \Psi(\pi_1 * \text{\textbackslash{}freeze}_3 : \text{P} \lor \text{TRANSITION} - \tau \rho (\text{state})))(\lambda y \lambda \pi_2. \text{\textbackslash{}freeze'}(e, x, y, \pi_2 * \text{\textbackslash{}freeze}_1 \text{\textbackslash{}become} + \text{\textbackslash{}ARG}_{\Psi} \text{\textbackslash{}TyPS}(\Psi)) \land \text{\textbackslash{}result'}(s, e, \pi_2 * \text{\textbackslash{}ARG}_{\text{\textbackslash{}result}1 : \text{\textbackslash{}frozen}(\text{\textbackslash{}ARG}_{\text{\textbackslash{}frozen}3})))))

b. General type FROZEN:
\[(P \Rightarrow \text{SOLID} \land \text{TEMP} < 0 \land \text{PRESERVED}) \lor (\text{TRANSITION} \Rightarrow \text{PRESERVED})\]

The difference between underspecification and coercion is visible on the type level, i.e. in the internal semantics. Underspecification is modelled as a dependent type and coercion as a polymorphic type. Whereas dependent types are types of some variable that is already present in the representation and whose specification hinges on the type of their parameter, polymorphic types are types of a variable that has to be interpolated depending on the parameter in order to satisfy the selectional restrictions of the functor featuring the polymorphic type. With this formal representation of underspecification and coercion, we mirror well-established conceptions of these two mechanisms. Other authors (Piñango and Deo, 2016; Egg, 2003; Dölling, 2003) understand underspecification as a semantically foreseen slot for contextual enrichment. In our account, dependent types do the same job on the type level: they systematically provide a semantic slot for contextual specification. The advantage of using dependent types is that we do not introduce variables that might end up being reduced to the identity function. Coercion is commonly understood as a repair mechanism for combinatorial conflicts that results in the introduction of a new variable only if it is necessary; cf. Pustejovsky (1995), de Swart (2011) and Asher (2011). Our TCL-style coercion functor fulfils the same task. However, none of the cited accounts treats these two mechanisms as measures to model different sorts of phenomena. They are usually treated as mutually exclusive alternatives. Our account integrates these two mechanisms into one system and does it on linguistically well-established grounds.

5. Summary

We have presented a case study of a wide-spread phenomenon in predication that shows that combinatorial adaptability is almost ubiquitous. With this case study, we have illustrated that even the most mundane composition requires both underspecification and coercion. In our account, underspecification is modelled in terms of a dependent type that receives a specification upon the combination of functor and argument,\(^{14}\) whereas coercion is modelled in terms of a polymorphic type that resolves compositional conflicts by introducing an additional variable.

References


\(^{14}\)Other approaches have discussed similar ideas under the label co-composition; cf. Pustejovsky (1995) and Asher et al. (2017).


Degrees as nominalized properties: Evidence from differential verbal comparatives in Mandarin Chinese
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Abstract. Whether degrees should be modeled as simple semantic primitives or ontologically complex entities has been an issue in recent formal semantic research. This article aims to make a contribution to this scholarly enterprise by investigating the Differential Verbal Comparative (DVC) construction in Chinese. DVCs exhibit peculiar properties: (i) obligatory differentials, and (ii) DPs as differentials (e.g., liang ben xiaoshuo ‘two CL novel’). We propose that a degree is the entity correlate of a property that is formed on the basis of a measure, akin to Chierchia-style kind. This new kind of degree, coupled with a difference function-based semantics for comparatives, correctly predicts the behaviors of DVCs which would otherwise remain formally inscrutable. This article’s contributions are twofold: (i) it provides direct support for the degree-as-kind analysis by extending its empirical scope; and (ii) by combining degrees as kinds with a difference function-based semantics, it represents an improvement over the previous degree-as-kind analysis based on linear ordering.

Keywords: comparatives, degrees, kinds, Mandarin Chinese, differential verbal comparatives.

1. Introduction

Over the past several decades, there has been a significant amount of discussion on what exactly degrees are. Approaches to this question roughly fall within two schools, which bear distinct (though not completely incompatible) consequences for the semantics of comparatives:

(1) Two approaches to degrees: primitive vs. complex

(i) The standard approach: Degrees are semantic primitives formalized as points or intervals on an abstract scale, akin to real numbers (cf., Seuren, 1973; von Stechow, 1984; Heim, 1985; Kennedy, 1999; Schwarzschild and Wilkinson, 2002; Kennedy and McNally, 2005; Kennedy, 2007; Beck, 2012);

(ii) The not-so-standard approach: Degrees are not semantic primitives, but rather ontologically complex entities. Research within this approach treats degrees as equivalence classes (Cresswell, 1976), as tropes (Moltmann, 2009), oras kinds (Anderson and Morzycki, 2015; Scontras, 2017). The interested reader can also refer to Grosu and Landman (1998) and Castroviejo and Schwager (2008) for relevant discussion.

There are many unresolved issues on this topic. For example, do all comparatives make use of the same kind of degree? If not, is it possible for some comparative constructions to make

1 We would like to thank Curt Anderson, Thomas Grano, Miao-Ling Hsieh, Chris Kennedy, Xiao Li, , and Yafei Li for constructive comments on an earlier draft of the paper. We are also indebted to Manfred Krifka, Louise McNally, Stephanie Solt, and other scholars in the audience of Sinn und Bedeutung 22 for inspiring suggestions and comments. This work is financially supported by National Social Science Foundation of China (NSSFC) under grant # 16BYY006 to Qiongpeng Luo.

use of degrees as points, while other comparative constructions make use of degrees as kinds? Is there any empirical evidence for the degree-as-kind vs. degree-as-point dichotomy? If so, what regulates between them?

These issues get more complicated in the face of data from Mandarin Chinese. Recently, one case of within-language variation among comparative constructions in Mandarin Chinese has been identified and intensively studied: comparative constructions making use of degree ordering along some scale vs. comparative constructions making use of direct comparison of two sets of individuals with no reference to, or mediation by, degrees. While comparative constructions such as the bi adjectival comparative (AC) and the transitive comparative have been argued to represent the first comparison strategy (Xiang, 2005; Lin, 2009; Grano and Kennedy, 2012), Li (2009, 2015a) takes the differential verbal comparatives (DVCs) in Mandarin Chinese to exemplify what she calls “degreeless comparison”, which in her analysis involves one-to-one mapping between two sets of individuals. The degree-based comparison vs. degreeless comparison is exemplified by the examples in (1)-(2), respectively:

(2) Degree-based comparatives: bi adjectival comparatives (ACs)

Zhangsan bi Lisi gao (san gongfen).
‘Zhangsan is (three centimeters) taller than Lisi.’ Lin (2009); Grano and Kennedy (2012)

(3) Degreeless comparatives: differential verbal comparatives (DVCs)

Zhangsan bi Lisi duo du-le *(liang ben xiaoshuo).
‘Zhangsan’s reading exceeded Li’s reading by two novels.’ Li (2015)

DVCs () differ from ACs in two respects: (i) differentials in DVCs are obligatory, while differentials in ACs are optional, and (ii) differentials in DVCs can take the form of DP, e.g., liang ben xiaoshuo ‘two CL novels’, while differentials in ACs can only be measure phrases (MPs), e.g., san gongfen ‘three centimeters’. These two peculiarities of DVCs stand out and challenge the standard semantics of degrees and DPs.

This article aims to offer a motivated explanation for the seemingly inscrutable properties of DVCs: Why do DVCs allow DP-like differentials? Why are differentials obligatory in DVCs? Setting in a broader cross-linguistic context, we note that DPs -- and their close cousins, relatives clauses (RCs) -- denoting degrees are widely attested across languages. In light of recent studies on gradability and comparison (especially Anderson and Morzycki, 2015; Scontras, 2017), we motivate an analysis that treats degrees as equivalence classes (Cresswell, 1976), or Chierchia-style quantity- and quality-uniform properties (Chierchia, 1998; McNally, 2001; Scontras, 2017). However, adopting a degree-as-kind analysis does not tackle all the problems raised by DVCs. One standing issue has to do with the semantic composition: since kinds, unlike points, are not linearly ordered, the compositionality becomes a non-trivial issue in this degree-as-kind analysis. To fix this problem, we take a revisionist strategy. On the one

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2 Abbreviations are as follows: ASP: aspectual markers; BI: bi (a marker to introduce the standard of comparison); CL: classifiers; DE: modification marker de; DEM: demonstratives; DUO: duo. To eliminate controversy, in this article, we gloss duo simply as DUO, although it has been glossed either as ‘more’ or ‘many/much’ in the literature.
hand, we follow the most recent works such as Anderson and Morzycki (2015) to treat degrees as kinds. On the other hand, we discard their semantics for comparatives based on linear ordering. Instead, we adopt a difference function-based semantics for comparatives. We demonstrate that this new semantics that combines degree-as-kind with difference functions not only correctly predicts the behaviors of DVC sentences, but desirably circumvents the problems faced by Anderson and Morzycki (2015).

2. Differential Verbal Comparatives in Mandarin Chinese

A typical DVC sentence comprises four components: (i) a target of comparison (DP₁), (ii) an optional standard-of-comparison phrase introduced by the morpheme bi ([bi DP₂]), (iii) a verb introduced by duo or shao, and (iv) an obligatory differential phrase, as exemplified by liang-ben xiaoshuo ‘two CL novels’ in (4b).

(4) a. DP₁ (bi DP₂) duo/shao V *(differential phrase)
   b. Zhangsan bi Lisi duo du-le liang ben xiaoshuo
      Zhangsan BI Lisi DUO read-ASP two CL novel
      ‘Zhangsan read two more novels than Lisi did.’

At least three features merit further discussion. First, although as shown in (4b), some DVC sentences can be translated into amount comparatives in English, DVCs and amount comparatives are by no means alike. Suppose, for instance, both Zhangsan and Lisi went for shopping, Zhangsan bought one cellphone and one Surface Pro, Lisi only bought one Surface Pro. The following sentence in (5), taking the form of DVC, can be felicitously used to describe this situation, while the same situation cannot be felicitously expressed by amount comparative in English::

(5) a. Situation: Zhangsan bought a cellphone and a Surface Pro, Lisi only bought a Surface Pro:
   b. Zhangsan bi Lisi duo mai-le shouji.
      Zhangsan BI Lisi DUO buy-ASP cellphone
      ✓ ‘Zhangsan bought one more thing than Lisi, which is cellphone.’
      ✗ ‘Zhangsan bought more cellphone than Lisi.’

Second, besides regular MPs such as san mi ‘three meters’, san gongjin ‘three kilos’, differential phrases in DVCs can take almost all forms of DPs: an indefinite DP, a kind-denoting term (realized as bare nouns in Chinese), and even a proper name, as illustrated by (6a-c), respectively:

(6) a. Differential phrase = indefinite DP:
      Zhangsan bi Lisi duo du-le liang ben xiaoshuo
      Zhangsan BI Lisi DUO read-ASP two CL novel
      ‘Zhangsan read two more novels than Lisi did.’
   b. Differential phrase = kind-denoting term:
      Zhangsan bi Lisi duo mai-le shouji.
      Zhangsan BI Lisi DUO buy-ASP cellphone

For more about amount comparatives, see Morzycki 2016 (Ch. 6) and references therein.
‘Zhangsan bought one more thing than Lisi, which was a cellphone.’
c. **Differential phrase = proper name:**

Zhangsan bi Lisi duo qu-le New York.
Zhangsan BI Lisi DUO go-ASP New York
‘Zhangsan went one more place than Lisi, which was New York.’

By contrast, for ACs, differential phrases can only take the form of MP:

(7) Zhangsan bi Lisi gao {liang limi / *liang ben shu}.
Zhangsan BI Lisi tall two centimeters/ two CL books
‘Zhangsan is {two centimeters/*two books} taller than Lisi.’  

Third, as pointed out by Li (2015a), unlike *bi* ACs, differentials in DVCs are obligatory.

The differences between DVCs and ACs can be summarized as follows:

<table>
<thead>
<tr>
<th></th>
<th>Standard marker</th>
<th>Predicates of comparison</th>
<th>Obligatory differentials</th>
<th>MP differentials</th>
<th>DP differentials</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACs</td>
<td>bi</td>
<td>Gradable adjectives</td>
<td>-</td>
<td>+</td>
<td>−</td>
</tr>
<tr>
<td>DVCs</td>
<td>bi</td>
<td>Duo/shao + V</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

Obviously, DVCs pose non-trivial challenges for both the standard semantics of degrees (as points on a scale) and DPs (presumably referring to mere individuals). Here is a **Comparative Puzzle** in Chinese:

(8) A Comparative Puzzle

(i) If both DVCs and ACs are comparisons of degrees, then we are forced to accept the conclusion that DPs have the same denotations as MPs, i.e., both refer to degrees, contracting the standard view that DPs refer to individuals.

(ii) If DVCs are fundamentally different from ACs, then we miss a unified account of comparatives, and we are unable to explain the commonalities between them, for example, why both take the comparative form and involve the same standard marker *bi*.

In the literature, Li (2009, 2015a) is the first serious attempt to provide a detailed empirical description and semantic analysis of DVCs. Before presenting our account, a critical review of her analysis is in order.

3. The previous analysis

3.1 Li’s (2015) mapping-based account of DVCs

Li’s analysis of DVCs is largely based on two assumptions: (i) when the verb following *duo/shao* is transitive or di-transitive, the differential DP in the DVC sentence is individual-denoting DP, which presumably does not denote a degree; and (ii) different from (direct or
indirect) comparison of degrees, comparison of two sets of individuals calls for mapping between two sets, rather than degree ordering.\(^4\) According to this analysis, the predication of the verb on the subject (DP\(_1\)) yields a set A, and the predication of the verb on the standard-of-comparison phrase (DP\(_2\)) yields another set B. *Duo* establishes a mapping relation whereby every element in set B is paired with a unique and different element in set A. The differential DP denotes the subset of set A whose elements are left unpaired with those in set B. Formally, Li defines the semantics of *duo* as in (9a), where “\(\circ\)” is an overlap relation.

\[(9)\] a. \([\text{[duo]}]\)\(^b\)=
\[
\lambda P.\lambda x.\lambda y.\lambda z.\forall (z)\forall x.\forall y.\forall z.[P(z)(y)\rightarrow \exists t.[t=g(f)(z)\land \text{PROPER}(g(f)) \land P(t)(x)\land P(k)(x)\land \neg t\circ k]]
\]

b. \(\text{PROPER}\) is a function (of type \(\langle\epsilon,\epsilon\rangle,\text{t}\rangle\)) which is true of \(g(f)\) iff \(g(f)\) preserves the taxonomic level introduced by the differential phrase.

The definition of *duo* in the DVC construction requires four semantic arguments: (i) a two-place predicate \(P\) corresponding to the verb \(V\) in (4a), (ii) an individual \(k\) corresponding to the differential phrase, (iii) an individual \(y\) corresponding to \(\text{DP}_2\), and (iv) an individual \(x\) corresponding to \(\text{DP}_1\). The function \(f\) in the definition is a mapping function, whose value is assigned by the assignment function \(g\). This definition involves a mapping between two sets of individuals to which \(\text{DP}_1\) and \(\text{DP}_2\) relate by way of the predication as specified by \(V\). It identifies the difference between the two sets with the denotation of the differential phrase. In addition, Li’s analysis requires, by way of a PROPER function as defined in (9b), that all the individuals under mapping be of the same taxonomic sort/level. The taxonomic information is specified by the differential phrase.

The LF structure that Li assumes for the above semantics of *duo* is given in (10) (Li (2015a): Ex. (48)). On this account, the morpheme *bi* projects a PP, and it is semantically vacuous. The standard-of-comparison phrase is a simple PP complement. It does not have any clausal syntactic structure, and does not denote a degree argument. The semantic interpretation of the sentence is spelled out in (11). It states that for each novel read by Lisi, Zhangsan read a matching copy, and that there are two novels that Zhangsan read but for which Lisi did not read matching copies.

\[(10)\] \([S [\text{liang ben xiaoshuo} [S \lambda i. [\text{VP} [\text{DP} \text{Zhangsan}] [\text{VP} [\text{PP} \text{bi Lisi}] [\text{VP} [V \text{duo du-le} ] t]]\ldots
\]

\[(11)\] \([\text{Zhangsan bi Lisi duo du-le liang ben xiaoshuo}]\]
\[
= \exists x.[\text{novel}(x) \land \#x \geq 2 \land \forall z.[\text{read}(z)(Lisi) \rightarrow \exists t.[t=g(f)(z) \land \text{PROPER}(g(f)) \land \text{read}(t)(\text{Zhangsan}) \land \text{read}(x)(\text{Zhangsan}) \land \neg t \circ x]]]
\]

Li (2009, 2015a) claims that compared to a degree semantic account, her degreeless, mapping-based approach to the DVC construction fares better in accommodating important differences observed between the *bi* ACs and the DVC. First, as shown above, *duo* and *shao* are the only two elements that can be used right before a verb to form a DVC sentence, and other gradable adjectives or adverbs cannot ((12), repeated from 63(a-b) in Li (2015a)). Li’s

\(^4\) Li (2009, 2015a) takes *duo* to be ambiguous depending upon the argument structure of the verb and, relatedly, the lexical category of the differential phrase. For the sake of simplicity, our primary focus in this paper is on cases where the verb following *duo/shao* is a transitive verb and where the differential phrase is not a measure phrase or factor phrase.
explanation is that gradable adjectives and adverbs like *kuai* ‘fast’ and *renzhen* ‘attentively’ are standardly analyzed to involve relations between individuals and degrees. She argues that the difference in semantic type disallows gradable predicates other than *duo* and *shao* in the DVC construction.

(12) a. *Zhangsan bi Lisi kuai pao-le liang gongli.
   Zhanagsan BI Lisi fast run-ASP two kilometer
b. *Zhangsan bi Lisi renzhen du-le liang ben shu.
   Zhanagsan BI Lisi attentively read-ASP two CL books

Second, recall that a differential phrase is required in a DVC sentence, whereas it is optional in a *bi* AC sentence. On Li’s mapping-based account, in addition to denoting the relevant difference, the differential phrase is needed in the DVC so as to mark the taxonomic sort/level whereby mapping is done. According to Li’s analysis, without a differential phrase, mapping would be random and baseless. For degree comparison, the dimension along which comparison is performed comes from the gradable predicate, and no separate taxonomic information is required for the comparison to be meaningful.

3.2 Problems with Li’s degreeless analysis

Li’s analysis is motivated by two assumptions: (i) differential DPs in DVCs are semantically akin to genuine individual-denoting DPs occurring in non-comparative contexts; (ii) DPs do not denote degrees. We demonstrate that both of the assumptions are challenged by empirical data.

Differential DPs in DVCs are by no means like DPs in non-comparative contexts. Evidence comes from two observations: (a) pronominalization: a differential DP in a DVC sentence cannot be referred back to by individual-denoting pronouns or empty categories, but can be referred back to by a degree/kind anaphor; (b) topicalization: differential DPs in DVCs cannot be topicalized, unlike genuine individual-denoting DPs in non-comparative contexts. Given these two empirical observations, Li’s evidence for treating differential DPs as individual-denoting does not warrant the conclusion that she intends for.

First, if differential DPs in DVC sentences have exactly the same semantics as genuine individual-denoting DPs occurring in non-comparative contexts, we should expect that they can be referred back to by pronouns or empty categories. This prediction is not borne out: (13) is at best marginally acceptable and stands in stark contrast with the perfectly acceptable sentence in (14).

(13) a. Zhangsan bi Lisi duo du-le [liang ben xiaoshuo].
   ??/* [Tamen/e],
   dou hen haokan.
   they/e DOU very interesting
   Intended: ‘Zhangsan read [two more novels]i than Lisi did. Theyi are both very interesting.’

b. Zhangsan bi Lisi duo du-le [liang ben xiaoshuo].
Zhangsan BI Lisi DUO read-ASP two CL novel
Wangwu ye duo du-le [tamen].

Intended: ‘Zhangsan read two more novels than Lisi did. And Wangwu read them, too.’

(14) Zhangsan jintian mai-le [liang ben xiaoshuo].
Zhangsan today buy-ASP two CL novel
[Tamen/e], dou hen haokan they/e DOU very interesting
‘Zhangsan bought [two novels], today. They are very interesting.’

By contrast, degree anaphors like zheme “such (this)” and na’me “such (that)” can be used to refer to differential DPs in DVC sentences.

(15) Zhangsan bi Lisi duo du-le [liang ben xiaoshuo].
Wangwu ye duo du-le [na’mei duo].
Wangwu also DUO read-ASP that many
‘Zhangsan read two more novels than Lisi did. Wangwu read these two novels more/that many more, too.’

Second, topicalization provides another compelling piece of evidence that differential DPs in DVCs are not individual-denoting. It has been widely accepted that topics in Mandarin Chinese are subject to a definiteness constraint (Chao, 1968; Li and Thompson, 1981). When this constraint is met, a DP can be topicalized, as shown in (16) below:

Zhangsan read-ASP Jane Eyre
b. [Topic Jane Eyre], Zhangsan du-le e.

If differential DPs in DVCs were indeed parallel to DPs in non-comparative contexts, then they should be able to be topicalized, provided that the definiteness constraint is satisfied. This prediction is not borne out, again. Even when differential DPs in DVC sentences take the form of proper names or demonstrative phrases, they normally cannot be topicalized:

(17) a. Zhangsan bi Lisi duo du-le zhe ben xiaoshuo.
Zhangsan BI Lisi DUO read-ASP Dem CL novel
b. */?? [Topic Zhe ben xiaoshuo], Zhangsan bi Lisi duo du-le e.

As a further note, genuine degree expressions cannot be topicalized in Mandarin Chinese:

(18) a. Zhangsan bi Lisi gao liang limi.
Zhangsan BI Lisi tall two centimeters
‘Zhangsan is taller than Lisi by 2 centimeters.’

Based on the above evidence, we postulate that differential DPs in DVC sentences still involve degrees, not individuals alone. (19) below is another natural example demonstrating that differential DPs in DVC sentences denote degrees. In the context of talking about paper product consumption, (19) can be understood to mean that paper consumption in America exceeds that in China by the amount of xylem fiber worth of the forest in question can produce, not the physical forest itself.

(19) Meiguo yi nian yao bi zhongguo duo xiaohao yan-qian zhe pian senlin.
   US one year will BI China DUO consume eye-before this CL forest
   ‘The US will consume the-forest-before-us-worth more (paper) than China in one year.

Our observation that differential DPs in DVC sentences involve degree semantics actually reconfirms the long-held view that DPs can have a degree component. Grosu and Landman (1998: 132) cites the English example in (20) (originally due to Heim (1987)) whose most natural reading is about drinking the same amount of champagne as was spilled, though one can imagine a stretched situation in which people, like curly dogs, are licking up the ground.

(20) It will take us the rest of our lives to drink [DP the champagne that they spilled that evening].

Furthermore, degree-denoting DPs are widely attested in many languages, most of them are typologically unrelated to Mandarin Chinese. Rett (2014) reports a number of cases in English in which DPs denote degrees, not individuals (21) (see also Cresswell, 1976). The Romanian example (22), repeated from Rett’s (15) (due to Grosu (2009)), illustrates the same pattern. According to Grosu, the gap associated with the wh-phrase cât “is the internal argument of a predicate that selects degrees (on a scale that the predicate specifies)”. Degree-denoting DPs are also found in Hindi-Urdu, which employs a correlative (which takes the form of a DP) to convey comparison between two degrees. (23) is from Bhatt and Takahashi (2011: 593). Degree-denoting DPs taking the form of relative clauses are also attested in Japanese, a language geographically close but genetically unrelated to Mandarin Chinese. According to Sudo (2015), the complement of yori in (24) should be analyzed as a relative clause headed by a covert element that denotes a degree.

(21) English ( Rett 2014)
   a. Four pizzas is more than we need. [degree interpretation]
   b. Many guests is several more than Bill anticipated. [degree interpretation]

(22) Romanian (Grosu 2009)
   (Cele) nouă kilometri cât cântărește bagajul tău de mână nu
   DEM nine kilos how-much weighs luggage-the your of hand not
   te vor împiedica să te urci in avion
   you will-PL prevent SUBJ REFL climb-1SG in plane
   ‘[DP (The) nine kilos that your handbag weighs] won’t prevent you from boarding the plane.’

(23) Hindu-Urdu (Bhatt and Takahashi 2011)
In this section, we have demonstrated that the assumptions motivating Li’s degreeless analysis of DVCs are unwarranted. Next, we will provide an account that takes degrees to be individual correlates of properties (i.e., nominalized properties) to accommodate the observed facts in relation to DVCs.

4. Toward a new kind of degree

In the standard degree-based framework, degrees are “abstract representation of measurement”, modeled as points along an abstract scale, akin to real numbers (Seuren, 1973; von Stechow, 1984; Schwarzschild and Wilkinson, 2002; Kennedy and McNally, 2005; Beck, 2012; Morzycki, 2016). We agree with Li (2009, 2015a) that DVCs in Mandarin Chinese, which allow DPs to function as differential phrases, pose non-trivial challenges for this degree-as-point analysis. At the same time, as we have shown, Li’s alternative degreeless analysis relying on the one-to-one mapping between two sets also runs into difficulty. An adequate account of the DVC facts calls for a reconsideration of the ontology of degrees.

An early alternative approach to the degree-as-point analysis can be traced back to Cresswell (1976), which places degrees in the model, but does not treat them as primitives. Cresswell analyzes the plural count noun men as at times denoting “x is a set of men” and at other times denoting “x is a y-membered set of men”, where y is a variable over cardinalities (pp. 277-278). He defines degrees as equivalence classes, viz., groups of individuals that are the same with respect to some measure (a particular gradable property) such as weight and height. (p. 281). 180 centimeters, for instance, is the class of pairs of a world w and an individual x such that individual x is 180 centimeters tall in world w (Castroviejo and Schwager, 2008).

Cresswell’s seminal idea ushered in an approach that adopts a richer ontology of degrees. For example, Grosu and Landman (1998) treat degrees as tuples of an individual, a property, and a measure, Moltmann (2009) takes degrees to be tropes, Anderson and Morzycki (2015) argue for a deep connection between degrees and kinds. Most recently, Scontras (2017) studies the degree noun amount in English and proposes that a degree is an individual correlate of a property that is formed on the basis of some measure. Consider:

(25) a. I ate that amount of apples every day for a year.

An alternative view is to taking degrees as intervals (Wilkinson and Schwarzschild 2002). It should be noted that taking degrees as intervals does not circumvent the challenges posed by DVCs, since both degree-as-point analysis and degree-as-interval analysis are based on the notion of cardinality (Kennedy 2007, 2009).
b. I ate the amount of apples that you ate.
c. I want the amount of apples that Bill received.

In (25a), it is weird that the speaker eats the same apples each day. Similarly, for (25b), it is highly unlikely that the speaker and the addressee eat the same apples. In (25c) *the amount of apples* refers to some abstract amount, say, 3 kilos of apples. It is clear that in these existential interpretations, there are two semantic components: an abstract amount/measure, and the objects that instantiate the amount/measure.

Exactly the same pattern is observed for DPs in Chinese. Depending on predicate types, DPs are open to different interpretations. In (26a), *san men ke* ‘3 CL course’ refers to a set of courses, whose cardinality is three. In (26b), *san men ke* ‘3 CL course’ is used as a differential in a DVC construction, which receives an existential interpretation, just like *amount* does in (25).

\[(26)\]

   Zhangsan take-ASP three CL course
   ‘Zhangsan took three courses.’

   Zhangsan BI Lisi DUO take-ASP three CL course
   ‘Zhangsan took three more courses than Lisi did.’

The standard knowledge of DPs is that they refer to individuals. The semantics of *san men ke*, for example, can be defined as:

\[(27)\] \[\langle san men ke \rangle = \lambda x. \#x=3 \land *course (x)\]

However, *san men ke* ‘3 CL course’ in (26b) does not merely refer to individual courses: it cannot be referred back to by pronouns; nor can it be topicalized. At the same time, *san men ke* in (26b) does not refer to mere numbers (i.e., cardinality), either, because (26b) does not mean there is a set of numbers that Zhangsan took but Lisi didn’t take. On the contrary, *san men ke* is a “combination” of both the measure and individuals: the speaker specifies a cardinality/measure, which is instantiated by courses. Treating it either as mere individuals or mere numbers would yield the wrong result.

Breaking away from the standard degree-as-point analysis, Scontras (2017) treats degrees as nominalizations of quantity-uniform properties. That is, degrees reference both abstract representation of measurement and the objects that instantiate that measurement. In short, degrees are entity correlates of properties (McNally 2009). Scontras employs the conceptual machinery of “properties” and “kinds” in Chierchia’s (1998) to flesh out this idea. Chierchia posits that all first order properties have counterparts in the entity domain such that for any natural property, like the property of being a dog, there corresponds a kind, viz. the dog kind. He defines two semantic operations which relate properties to their entity correlates, and vice versa. The first one is the nominalization process which derives kinds from properties via the “down” operator \(\cap\), and the second one, the predicativization process, operates in the opposite direction, which retrieves properties from kinds via the “up” operator \(\cup\). The semantics for these two operators are repeated as below (Chierchia 1998: 349):
Chierchia conjectures that for any atomic type, there is a kind counterpart. But what exactly is a kind? The kind PANDA consists of all possible (instantiations of) pandas (all the pandas in every possible world). More precisely, the kind is a function from a world to a (typically plural) individual consisting of all the pandas in that world. Correspondingly, to be a realization of the kind PANDA is simply to be a member of the plurality of pandas in a world. This idea echoes with what Cresswell (1976) envisions about the deep connection between individuals and degrees. For him, the degree ‘6 feet tall’ is an equivalence class—it contains the plurality of individuals that are 6 feet tall. More specifically, we could think of ‘6 feet tall’ as a function from a world to the plurality of 6-foot-tall individuals in that world. This is essentially a Chierchia-style kind. Intensionalizing equivalence classes, we arrive at a Chierchia-style kind:

\[ [6 \text{ feet man}] = \lambda x. \mu(x) = 6 \text{ feet } \land \text{man}(x) \]

For every kind \( k \), there is a corresponding property satisfied by all and only its realizations. \( \cup \) is the property counterpart for a kind \( k \), where \( \cap \) is the kind corresponding to a property \( P \). If \( k \) is a degree-kind of being 6 feet tall, then \( \cup k \) is a property of being 6 feet tall (viz. a set of individuals whose height is 6 feet).

\[ \neg \lambda x. \mu(x) = 6 \text{ feet } \land \text{man}(x) = \lambda x. \mu(x) = 6 \text{ feet } \land \text{man}(x) \]

For our current purposes, we adopt a simplified version of Scontras’ definition of degree (Scontras 2017: 178):

\[ \text{DEGREE} := \lambda x. \exists k[\mu(x) = n \land \cup k(x)] \]

(31) The definition in (31) treats degrees analogously to Chierchia-style kinds. Degrees are conceived of as information bundles with four coordinates <\( \mu \), \( n \), \( k \), \( \cup \)>: a measure realized by the measure function \( \mu \) (e.g., the kilogram measure, the meter measure, etc.), a value in terms of numbers \( n \), a kind \( k \), and the Chierchia-style “up” \( \cup \) operator which applies to a kind and returns the property from which the kind is built. In other words, degrees are quantity- and quality-uniform properties, they reference both the abstract measure/amount and the real world objects that instantiate the measure/amount. This new kind of degrees as kinds promises a more motivated account of DVC facts, as to be shown in the rest of this work.

Where properties are of type <\( s \), <\( e \), \( t \)> and kinds of type \( e \). Example: \( \cap \text{PANDA} = k \)

\( \cup k = \text{PANDA} \)
5. The semantics of DVC sentences

Having settled on the semantics of degrees, the next task is to determine how this new semantics of degree enters into the semantic composition of DVC sentences to derive the correct truth conditions. This is by no means straightforward.

Anderson and Morzycki (2015) have sketched a semantics for comparatives in a degree-as-kind analysis. They assume the comparative morpheme –er to have the semantics in (33)

\[
\lambda k \lambda s'. \exists k' [k'(s') \land k' > s_k]
\]

This semantics is conceptually problematic. Since degrees are kinds, not as real numbers along an abstract scale, it is mysterious how kinds are compared and ordered, as shown by the expression “k’ > s_k”. Applying the “up” ∪ operator to retrieve properties from kinds would not help, either, because it is the extensions of a property, not the property itself, are compared and ordered. In other words, the denotation in (33) name entities of the wrong sort.

In the following, we provide a semantics for the DVC sentences that discards this semantics based on linear ordering while still conceiving of degrees as kinds.

First, look at the semantics of differential DPs. Take san-ben shu ‘three-CL book’ as an example. For its syntax, we simply assume that it is some DP-like projection. The “Num-CL” sequence san-ben functions as the modifier to the root noun shu ‘book’, which is a kind (type <e^k>). The degree reading of san-ben shu comes from a covert measure operator Δ (modeled after Scontra’s (2017) amount, read as amount or worth), which connects a kind-denoting term with the measure of the instantiation of that kind. The semantic derivation proceeds as in (35).

\[
\begin{align*}
\text{(34)} & \\
\text{(35) a. } & \text{[shu]} = \text{book} & (<e^k>) \\
\text{b. } & \text{[Δ]} = \lambda k \lambda n \lambda d [d = \lambda x, \mu(x) = n \land k(x)] & (<e^k, <n, d>) \\
\text{c. } & \text{[Δ]} (\text{[shu]}) = \lambda n \lambda d [d = \lambda x, \mu(x) = n \land \text{book} (x)] & (<n, d>) \\
\text{d. } & \text{[san ben]}: 3 & (<n>) \\
\text{e. } & \text{[san ben [Δ shu]]} = \lambda d [d = \lambda x, \mu(x) = 3 \land \text{book} (x)] & (<d>) \\
& = \lambda x, \mu(x) = 3 \land \text{book} (x)
\end{align*}
\]

The end result is a degree as nominalized properties. It references both the measure/cardinality (n=3) and the books that instantiate the measure.
Now consider how the differential DPs (as degree kinds) interact with the structures of DVC sentences in which they participate. To repeat one previous example:

(36) Zhangsan bi Lisi duo du-le *(san ben shu).
    Zhangsan BI Lisi DUO read-ASP three CL book
    ‘Zhangsan read three more books than Lisi did.’

Since DVC sentences are about measuring events, we adopt a Kratzerian VoiceP (Kratzer, 1996). The matrix subject Zhangsan start from a low, VoiceP-internal subject position. We also follow Lin (2009) to assume that bi Lisi is adjoined to the VoiceP. No more conceptual machinery is needed to derive the structure of (36).

The crucial part is to settle down the exact semantic of duo ‘more’. Before proceeding, consider the following situation:

(37) Situation: John had a cup of coffee and a donut for this morning. Mary only had a cup of tea.

(38) John bi Mary duo chi-le tian-tian-quan.
    John BI Mary DUO eat-ASP donut
    ‘John’s consumption exceeded Mary’s by one donut.’

The scenario depicted in (37) can be felicitously expressed by (38), which means John had one more thing (i.e., a donut) than Mary did. This semantics can be expressed by means of difference:

(39) Difference: A is different from B with respect to donut (x) such that A had x but B did not ⇒ In terms of what A and B had, A had x but B did not ⇒ A exceeded B by having x.

Obviously, a difference-based analysis entails the A-not-A analysis (Schwarzschild, 2008). We assume that the major semantic function of duo ‘more’ or shao ‘less’ in DVC sentences is to express the difference between two individuals x and y with respect to a certain property (or its kind counterpart k). In the formal literature, there have been some proposals that take comparative morphemes as difference functions (cf. Kennedy and McNally, 2005; Svenonius and Kennedy, 2006; Kennedy and Levin, 2008, among others). In standard degree-based semantics, a difference function is a measure function to measure the degree to which two objects diverge relative to a scalar dimension (Grano and Kennedy, 2012: 235-238). We extend the difference function from the domain of degrees as points to the domain of degrees as kinds. The difference function-based lexical entry of duo is defined in (40):
As shown in (40), *duo* takes five arguments: a predicate P, a target of comparison y, a standard of comparison x, a degree d, and an event e. In prose, (40) states that an individual y is different from x with respect to P relative to some measure d such that y holds of P at d but x does not. Actually, this semantics entails an A-not-A analysis.

(41) \[ P(e) \cdot (d) \cdot (y) = 1 \iff \exists d \in D \cdot [P(e)(d)(y) = 1 \land P(e)(d)(x) = 0] \]

The semantic composition DVC sentences becomes straightforward on this analysis. To illustrate, consider (42) below:

The step-by-step semantic derivation is provided as in (43):

(43) a. \[ \langle \text{san ben shu} \rangle = \lambda u. \mu f(u) = 3 \land \text{book}(u) \]

b. \[ \langle \text{du-le} \rangle = \lambda e. \text{read}(e) \land \text{Theme}(e) = z \]

c. \[ \langle \text{duo} \rangle = \lambda P \cdot v. \cdot e. \cdot d. \cdot \lambda x. \lambda y. \lambda e. \cdot \lambda v. \cdot P(e)(d)(x)(y) \]

d. \[ \langle \text{duo du-le} \rangle = \lambda d. \lambda x. \lambda y. \lambda e. \cdot \lambda v. \cdot \text{read}(e)(d)(x)(y) \]

e. \[ \langle \text{duo du-le san ben shu} \rangle = \lambda x. \lambda y. \lambda e. \cdot \lambda v. \cdot \text{read}(e)(d)(x)(y) \]

f. \[ \langle \text{Zhangsan bi Lisi duo du le san ben shu} \rangle = \lambda v. \lambda e. \cdot \lambda v. \cdot \text{read}(e)(d)(x)(y) \]

(44) \[ \langle \text{Zhangsan bi Lisi duo du le san ben shu} \rangle = 1 \iff \exists d \in D \cdot [P(d)(ZS) = 1 \land P(d)(LS) = 0] \]

= \exists x \cdot \left[ \mu f(x) = 3 \land \text{book}(x) \land \text{read}(x)(ZS) \land \neg \text{read}(x)(LS) \right]
Overall, (44) says that “Zhangsan bi Lisi duo du-le san ben shu” is true iff there is some instantiation x of the book kind whose cardinality is 3 such that Zhangsan read x but Lisi did not read (the same thing). Needless to say, this semantics delivers the right truth conditions.

6. Explaining the facts

The present analysis garners one immediate advantage: Since kinds can be freely turned into properties via predication, with the familiar Derived Kind Predication (DKP), this analysis nicely captures the double behaviors of DPs whereby they reference individuals and reference degrees as kinds at the same time (cf., (26a) and (26b)). The present analysis also answers the challenges that DVC sentences pose for the standard semantics. We have shown before that differential DPs in DVC sentences do not manifest the full range of properties associated with individual-denoting DPs. For example, differential DPs in DVC sentences cannot be referred back to by pronouns or empty categories, while they can be referred back to by the degree/kind modifier na’me ‘that such’. To repeat one previous example:

(45) Zhangsan bi Lisi duo du-le [liang ben xiaoshuo].
Zhangsan bi Lisi DUO read-ASP two CL novel
??/* [Tamen/e], dou hen haokan.
ye/e DOU very interesting

This is expected on the present account. Differential DPs denote degrees, and degrees have a different semantics than individuals, and this is why they cannot be referred back to by pronouns/empty categories in DVC sentences. This is further entrenched by the fact they can be referred back to the degree/kind modifier na’me, as shown before.

Another challenge is why differentials are obligatory in DVC sentences. According to Li (2009, 2015a), differential DPs in DVC sentences “indicate at what taxonomic level a mapping relation is established.” More specifically, Li argues that certain differential DPs in DVC sentences encode taxonomic information that is necessary for the semantic computation of those sentences. She claims that this extra taxonomic requirement lends support to separating such differential DPs from degree-denoting MPs.

We agree with Li’s idea that the standard degree-as-point analysis fails to capture the taxonomic information in differential DPs. But her objection should not apply to the present analysis. On the present account, degrees are quantity- and quality-uniform properties, which means they have two semantic components: besides the measure component, they have another component that contributes properties. Taxonomic information in the different DP is maintained in the present analysis. For example, Jane Eyre he Pride and Prejudice ‘JE and PP’ and Little Women he Wuthering Heights ‘LW and WH’ are two distinct pluralities and should not be confused with each other.

This idea provides a natural explanation for the obligatory status of differential DPs in DVC sentences, and relatedly, it also helps reveal what regulates between degrees as kinds and degrees as points. Consider the contrast between (46a) and (46b) below. Recall one essential

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6 Due to limitation of space, we have to leave the details aside. Interested readers can consult Chierchia (1998) for details about the shifting between individuals and kinds.
contribution of the gradable adjectives is to provide the dimension along which a scale structure is formed (Kennedy and McNally 2005). The example in (46a) is uninterpretable out of the blue. Lacking an adjective to supply a proper dimension, “three meters” in (46a) is unspecified: it is not clear what it measures (width, length, or height?).

(46) a.*Zhe zhang zhuozi san mi.
   Dem CL table three meters
b. Zhe zhang zhuozi san mi chang.
   Dem CL table three meters long
   ‘This table is three meters long./ The length of this table is three meters.’

In our analysis, neither duo/shao nor the verbal predicate in the DVC construction provides the necessary dimension for comparison. It falls on the differential phrase to supply the dimension information necessary for the comparison to be facilitated. Take (47) for example. (47a) lacks a proper dimension and sounds unnatural. Adding the differential phrase san gongli ‘three kilometers’ would supply the dimension of distance, and adding liang ge xiaoshi ‘two hours’ would supply the dimension of temporal duration. When the verbal predicate is transitive, the differential phrase has the additional function of serving as the object of the verb. Therefore, like Li, we conclude that differential phrases are obligatory in DVC sentences because they provide the dimension information needed to make the comparison meaningful.

(47) a. *Zhangsan bi Lisi duo pao le.
   Zhangsan BI Lisi DUO run ASP
b. Zhangsan bi Lisi duo pao-le san gongli / liang ge xiaoshi.
   Zhangsan BI Lisi DUO run-ASP three kilometers / two CL hours
   ‘Zhangsan ran three kilometers/two hours more than Lisi did.’

On the present account, differential DPs are obligatory in DVCs because they provide the sortal information needed to establish the dimensions of comparison. By contrast, in ACs, because gradable adjectives already contain the information about the dimensions for comparison, differentials become optional. The variation between ACs and DVCs can thus be reduced to how the dimensions for comparison are established, which can be ultimately couched in a theory involving some independently motivated principle of economy (cf., Chierchia’s (1998) Blocking Principle and Kennedy’s (2007) Interpretive Economy). We leave this topic for future research.

7. Conclusion

This article reexamines the Differential Verbal Comparative (DVC) construction in Mandarin Chinese. DVCs exhibit some peculiar properties: (i) obligatory differentials, and (ii) differentials taking the forms of DPs. Li (2015a) claims that the DVC construction is amenable to a mapping-based semantics that compares the individuals in two sets, rather than the cardinalities in two sets. This article takes issue with this degreeless, mapping-based analysis on the ground that the differential DPs in DVC sentences do not manifest the full range of properties of individual-denoting DPs in non-comparative contexts. Building on recent proposals on the ontology of degrees (Anderson and Morzycki, 2015; Scontras 2017),
this article proposes that a degree is the entity correlate of a property that is formed on the basis of a measure, akin to Chierchia-style kind. We demonstrate how this new kind of degree, plus a difference-based semantics for comparatives, nicely explains a wider range of empirical data concerning DVCs and is an improvement over the previous degree-as-kind analysis such as Anderson and Morzycki (2015).

References


**Abstract.** It is traditionally assumed that lexical causative verbs (e.g. *kill*) express direct causation only, while periphrastic (bi-clausal) causatives (e.g. *cause to die*) may also express indirect causation. In favour of this constraint, Fodor famously observed that the (change of) state introduced by lexical causative verbs is not accessible for separate adverbial modification by temporal (or manner) adverbials. In this paper, I present old and new arguments against the direct causation constraint under the definitions of directness of Fodor and Wolff. I then propose a new definition of directness in terms of *ab-initio causal sufficiency* framed in Kvart’s probabilistic account of singular causation. I argue that directness so redefined is an implicature rather than an entailment of lexical causative verbs, which enables me to account for old and new data. Furthermore, I account for why the constraint on separate modification by temporal adverbials can be relaxed with eventuality-denoting subjects.

**Keywords:** lexical causative verbs, direct vs. indirect causation, causal sufficiency, probabilistic theories of causation, semantics/pragmatics interface.

1. The direct causation constraint

It is traditionally assumed that lexical causative verbs (e.g. *kill*) express direct causation only, while periphrastic (bi-clausal) causatives (e.g. *cause to die*) may also express indirect causation. This constraint associated to lexical causative verbs, which I will call the ‘direct causation constraint’, has been defended under various forms by Ruwet (1972), Levin and Rappaport Hovav (1999) and Wolff (2003) among others. In favour of this constraint, Fodor (1970) famously observed that the (change of) state introduced by lexical causative verbs is not accessible for separate adverbial modification by temporal (or manner) adverbials, see (1).

(1) a. *Floyd melted the glass on Sunday* by heating it on *Saturday*.
   b. Floyd *caused* the glass to *melt* on *Sunday* by heating it on *Saturday*.

According to Fodor, this syntactic constraint ultimately reflects a semantic restriction on the type of causation events that lexical causatives describe; namely, the causal relation they encode may only have *temporally adjacent events* as relata. The same view is endorsed by Katz (1970), who

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1I am very grateful to Zsófia Gyarmathy and Christopher Piñón for extensive feedback, as well as to Jean-Pierre Koenig, Uli Sauerland, Florian Schäfer, Giorgos Spathas, the reviewers and audience of Sinn und Bedeutung 22 and the audience of the *Linguistic Perspectives on Causation Workshop* (Jerusalem, June 2017) for their very helpful comments. I also want to thank Katharina Fezer and Margaret Grant for the data collection in English and French, as well as Zsófia Gyarmathy and the editors of the Proceedings for proofreading and commenting on a former version of this paper. I am responsible for all remaining mistakes. This work is part of project B5 of the SFB 732 supported by the DFG and hosted by the University of Stuttgart.

2As he put it, ‘One can cause *something to melt* by doing something at a time which is distinct from the *melting event*. But if you melt something, then you melt it when it melts.’ (Fodor 1970: 433)
argues that the sentence in (2b) is false in what I will call the ‘Wild West story’ (2a), to which I will come back on several occasions below.

(2) a. *The sheriff’s six-shooter is faultily repaired by the gunsmith. As a result, two days later, the sheriff’s gun jams during a gunfight with the terrible Fred in a sordid pub, and the sheriff is shot to death.*
   
b. The gunsmith killed the sheriff.

Fodor and Katz understand directness as requiring temporal adjacency between the cause and the effect, so that no third event is allowed to intervene. But an alternative definition has been provided by Wolff (2003). In section 2, I present old and new arguments against the direct causation constraint under both definitions of directness. I then offer a new definition of directness in section 3, framed in Kvart’s (2001) probabilistic account of singular causation, and argue that directness so redefined is an implicature rather than an entailment of lexical causative verbs, what will enable me to account for the data presented in section 2. Finally, in section 4, I explain why separate modification by temporal adverbials is possible in some cases.

2. Against the direct causation constraint

Neeleman and Van de Koot (2012) offer a rich list of examples where the causing event is separated from its result by intermediate events, see e.g. (3). Note that most of these examples involve event- or state-denoting subjects.

(3) a. NHS supplies chaos killed my brother.
   
b. The gunsmith’s negligence killed the sheriff.
   
c. Opening bus lanes to motorcycles will redden the streets of London with cyclists’ blood.

In the tradition of discourse theory, Danlos (2001) relatedly observed that lexical causative verbs can be used when indirect causation is involved, as long as the restriction on separate adverbial modification observed by Fodor is respected, see her example (4).

(4) Fred killed Masha. He fired a shot at her on Sunday. She had an hemmorhage. She died on Monday.

Rappaport Hovav and Levin (2001: 783) also mention in passing that subevents of lexical causatives need not be temporally adjacent, observing that in their example (5), the act of putting arsenic in the coffee does not extend to the point where the drinker dies.

As already observed by R. Truswell in a p.c. reported in Neeleman and Van de Koot (2012: fn. 9). Neeleman and Van de Koot (2012) claim that this is not a condition for licensing indirect causal chains with lexical causatives, which I agree with, but it often facilitates this reading, what will be accounted for in section 3.
The widow murdered her guest by putting arsenic in his coffee. But in fact, even the restriction on separate adverbial modification can be relaxed in some contexts. For instance, my English and French informants all converge in the view that in presence of an event-denoting subject, separate adverbial modification is possible, see the English contrast (6a/b), as well as the French contrast (7).

(6) a. Fred accidentally shot his dog on December 23! He eventually killed him on December 25.
   b. Fred accidentally shot his dog on December 23! This gunshot eventually killed him on December 25.

(7) Mr Roy has shaken his baby of 3 months as a result 69 days later he/this has finished by him kill
     ‘Mr Roy shook his 3 months old baby. As a result, 69 days later #he/OK this eventually killed him.’

In both (6) and (7), the version with an individual-denoting subject is generally judged not acceptable. On the other hand, however, the version with an event-denoting subject is acceptable (under the relevant reading where the event denoted by the subject of the second clause refers back to the event introduced in the first clause, and thus takes place days before the time specified by the temporal adverbial in the second clause).

In (7), the presence of the verb finir par P, translatable by end up P-ing or eventually/ultimately P, is not innocent. This verb seems to facilitate the indirect reading of lexical causative verbs, as does the adverbial eventually in (6b). To illustrate the point more explicitly, I borrow from Lauer and Nadathur (2017) one of their scenarios repeated under (8). In this scenario, (8a) is inappropriate, but (8b/c), which contain the adverbial en fin de compte ‘eventually/ultimately’ or the implicative verb finir par ‘end up’, are much better, if not completely fine.

4 See also Beavers (2012: 923) for a related observation.
5 This version is only possible under the irrelevant reading where a killing event performed by the subject’s referent takes place at the time specified by the time adverbial in the second clause, not identified with the action described in the first clause.
6 The example (7) is adapted from a real occurrence found on https://tinyurl.com/y7geq6dh
7 Lauer and Nadathur (2017) focus on the semantic differences between different subtypes of periphrastic causatives, namely the English causatives make and cause, as well as the German causative lassen. The contrast obtained for French between (8a) and (8b/c) is very similar to what they observe for German lassen and English make. In particular, they claim that in the context (8), Das Erdbeben hat den Leuchtturm einstürzen lassen ‘The earthquake made the tower collapse’ is false, while Der starke Sturm hat den Leuchtturm einstürzen lassen ‘The strong storm made the tower collapse’ is true.
The lighthouse was built in a very sturdy foundation, designed to withstand high winds at the tower top, but the foundation sustained structural damage in an earthquake about ten years ago. Even that would have been fine, but this year, we had record-setting winds and the worst hurricane season anyone can remember, and given the prior damage, it could not take the extra strain provoked by the storms.

a. Le tremblement de terre a détruit le phare.
   ‘The earthquake has destroyed the lighthouse.’

b. En fin de compte, ce tremblement de terre a détruit le phare!
   ‘Ultimately, this earthquake destroyed the lighthouse!’

c. Et ce tremblement de terre a fini par détruire le phare!
   ‘And this earthquake eventually destroyed the lighthouse!’

Similarly, the sentence in (9) is generally judged more acceptable in the Wild West scenario (2a) than Katz’s original sentence (2b) (or its French counterpart).

En fin de compte, l’armurier a fini par tuer le shériff.
‘At the end of the day, the gunsmith ended up killing the sheriff!’

A final new relevant observation is that the indirect reading of lexical causatives is also facilitated in contexts such that the (change of) state described by the verb is taken for granted—through, for instance, clefting—while what is under issue is the responsibility of the subject’s referent, and/or what the ultimate causing event is. For instance, (10a) takes the lighthouse’s destruction for granted through the clefting and the focusing of the subject, and is much better in the lighthouse scenario (8). Similarly, (10b) is also more acceptable in the Wild West scenario (2a); see also the attested French example (11).

C’est le tremblement de terre qui a détruit le phare!
‘It is the earthquake that destroyed the lighthouse!’

It is the gunsmith (‘s mistake) that killed the sheriff!

Interestingly, many of the examples through which Neeleman and Van de Koot (2012) argues for the felicity of the indirect reading of lexical causative verbs also contain the adverbial eventually.

The example (11) is taken from an interview with Luz, a caricaturist of Charlie Hebdo, see https://tinyurl.com/y8eptebu
On a fait deux ou trois une sur Mahomet en quarante ans d’histoire. We have made two or three front pages on Mahomet in forty years of history of Charlie. C’est ça qui a été mis en avant par les médias, et c’est ça qui a tué nos amis.

‘We made a couple of front pages on Mahomet in forty years of Charlie’s history, and this is what has been put to the fore by the media and this is what killed our friends.’

Wolff (2003) famously proposed an alternative definition of direct causation, satisfied not only when there are no intermediate entities between the causer and the final causee, but also, if any intermediate entities are present, when those can be construed as an enabling condition rather than an intervening causer (that is, ‘does something that is concordant with the tendency of the causer’). However, the direct causation constraint is not respected in the examples discussed above even under this redefinition of directness. For example, (9) or (10b) are acceptable in the Wild West scenario (2a) although the intermediate causer cannot be conceived as ‘an enabling condition’, as illustrated by the inappropriateness of the paraphrase in (12a) in the relevant context; also, (12b) is not an adequate paraphrase of (11).

(11) On a fait deux ou trois une sur Mahomet en quarante ans d’histoire. We have made two or three front pages on Mahomet in forty years of history of Charlie. C’est ça qui a été mis en avant par les médias, et c’est ça qui a tué nos amis.

‘We made a couple of front pages on Mahomet in forty years of Charlie’s history, and this is what has been put to the fore by the media and this is what killed our friends.’

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(12) a. Fred enabled the gunsmith to kill the sheriff.
   b. The terrorists enabled the front pages to kill our friends.

To summarize, the causal relation expressed by lexical causative verbs may take place not only between two temporally adjacent eventualities, but also between two eventualities separated by intermediate events, even when intermediate causers are not enabling conditions in Wolff’s sense. The indirect reading of lexical causative verbs is favoured by the adverbials en fin de compte ‘ultimately, at the end of the day’, the verb finir par ‘end up, manage to’ as well as contexts where the occurrence of the state reported by the lexical causative is taken for granted (through, e.g., the clefting of the subject). Explaining the facilitating effect of these constructions on the indirect reading is the topic of section 3. Moreover, Fodor’s constraint on separate adverbial modification is relaxed with subject-denoting events, which I account for in section 4.

3. Time in probabilistic causation

3.1. Introduction

Let us compare again the following two sentences in the context of Katz’s Wild West story:

(13) a. Fred killed the sheriff in the bar (by shooting him).
   b. (By his negligence), the gunsmith killed the sheriff.

The possibility to paraphrase $x V-ed y$ by $z$ enabled $x$ to $V y$, $z$ being the intermediate causer, is the main independent criterium provided by Wolff (2003) to check whether the intermediate entity can be conceived as an enabling condition.
Let the variable $c$ represent the causing event, and $c_S$ the event the subject’s referent participates in (the shooting in (13a), the repair of the gun in (13b)). The causing event $c$ can either be identical to $c_S$, or include $c_S$ as a proper part if there is an intermediate event $c_I$ between $c_S$ and the outcome $o$. In the latter case, $c = c_S \oplus c_I$.

Let us assume a context such in both (13a/b), the constraint of temporal adjacency between $c_S$ and $o$ is violated. For instance, an intermediate event intervenes between $c_S$ (the act of Fred or the gunsmith) and the sheriff’s death $o$ (a lethal internal bleeding the day after the gunshot in (13a), a gunfight in a bar in (13b)). Still, in such a context, the causal relation expressed in (13a) feels more direct than the one expressed in (13b), and I suspect that subjects would be more willing to accept the lexical causative in (13a) than in (13b) when temporal adjacency is not satisfied. How, then, should directness be defined, if not by temporal adjacency?

An obvious difference between (13a) and (13b) has to do with the causal impact of the event involving the subject $c_S$. In (13a), $c_S$—the shooting—can be easily conceived as a sufficient cause for the sheriff’s lethal bleeding and his ensuing death. In (13b), however, $c_S$ (the repair) is certainly not sufficient for the sheriff’s death in the given scenario. A second related difference has to do with the way $c_S$ ‘indicates’ the sheriff’s death if we restrict knowledge to the facts that pertain up to $t'$, the right temporal boundary of $c_S$. On one hand, Fred’s shooting of the sheriff objectively points towards the sheriff’s death, in that it raises the objective chance that the sheriff will die in the epistemic context up to $t'$. Let us say that when $c_S$ raises the probability of $o$ in the epistemic context up to $t'$, $c_S$ ‘ab-initio causes’ $o$. On the other hand, the gunsmith’s repair, which is not known to be faulty at the time up to $t'$, does not raise the probability of the sheriff’s death at the time of the repair—it rather points to the contrary. That is, the gun’s repair does not ab-initio cause the sheriff’s death. It is only from a retrospective perspective, without limitations of knowledge of facts up to $t'$, once the intermediate history between the gun’s repair and the sheriff’s death is taken into account (and the gunsmith’s mistake identified), that the causal role of the gunsmith can be assessed. Let us say that in that case, $c_S$ ‘ex-post-facto causes’ the outcome $o$.

Ab-initio vs. ex-post-facto causality and the related statements will be defined more precisely below in the framework of Kvart’s (2001) probabilistic account of singular causation. This ultimately will enable us to define causal directness independently from temporal adjacency, and to account for the data presented in the introduction.

3.2. Kvart’s theory of causation and the evolution of probabilities in time

‘Probabilistic causation’ refers to a family of theories defining the relationship between cause and effect with the tools of probability theory. Central to these theories is the idea that causes change the probabilities of their effects, and more particularly that the occurrence of a cause increases

\[\text{Probabilistic causation} \]

11See Varasdi (2014) on the notion of indicative properties. Indicativity will here be defined through probabilities, but the notion is not very different from Varasdi’s notion of indicativity.
the probability of the effect. Particularly interesting for us are the theories of causation between event particulars that depend on the way probabilities change over time, such as the theory of Kvart (2001, 2004).

Assume that the propositions $C_S$ and $O$ are descriptions of the events $c_S$ and $o$ respectively, and let be $W_{C_S}$ the world history just before $c_S$ occurs. How should probability increase be defined to capture the notion of cause? As Kvart observes, the most natural idea is to interpret probability increase as in (14). That is, given the world history up to $C_S$, the probability of $O$ given $C_S$ is higher than the probability of $O$ given $¬C_S$.

$$(14) \quad P(O|C_S,W_{C_S}) > P(O|¬C_S,W_{C_S}) \quad \text{(ab-initio probability increase)}$$

One of Kvart’s crucial claims is that (14) is not an appropriate analysis of $C_S$ being a cause of $O$, despite the fact that this assumption is made in probabilistic theory such as Lewis’s. The reason is that (14) is a function of the world up to $C_S$, but not at all a function of $W_{C_S}, O$, the intermediate history from $C_S$ to $O$ (which justifies his label ab-initio probability increase for the condition (14)). In other words, from $C_S$, $O$, and $W_{C_S}$, (14) fixes whether $C_S$ is a cause of $O$, ‘regardless of what else transpires between’ $C_S$ and $O$. And as Kvart forcefully argues, this does not do justice to the fact that whether $C_S$ is a cause of $O$ very much depends on what happens within the intermediate history. Kvart (2004) therefore proposes an alternative definition of probability increase to capture the notion of cause that takes the intermediate history between $C_S$ and $O$ into account. He calls this notion ex-post-facto probability increase, which is ‘a sort of hindsight probability increase, from a bird’s eye view, with the intermediate history unfolded’ (Kvart 2004: 394). I illustrate the difference between ex-post-facto and ab-initio probability increase through three cases.

**Case 1.** Ex-post-facto probability increase can be easily illustrated through cases of ab-initio probability decrease (with ‘<’ instead of ‘>’ in (14)). Ex-post-facto probability increase despite of ab-initio probability decrease obtains when there is an intermediate event $c_I$ which increases the probability of $o$ when added to both sides of the ab-initio probability decrease condition, see (15a). Kvart calls such an intermediate event $c_I$ an increaser.

$$(15) \quad \begin{align*}
\text{a. } & P(O|C_S,C_I,W_{C_S}) > P(O|¬C_S,C_I,W_{C_S}) \quad \text{(ex-post-facto probability increase)} \\
\text{b. } & \text{Sasha’s bet improved her financial position.}
\end{align*}$$

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12See also Eells (1991), and Hitchcock (2010) for an introduction to probabilistic causation in general and singular causation and the evolution of probabilities in time in particular, on which I partly rely in the presentation.

13The probability function $P$ takes propositions as its arguments, but ‘events’ is the formal term for these arguments in probability theory. In the case of singular causation, these ‘events’ correspond to what event semanticists call events (or to facts for some other authors). But since the formalism requires to make use of negation, disjunction or conjunction on these relata, these must be propositional entities. I assume that the (upper case) variables $C$ and $O$ correspond to propositions that are descriptions of the events picked up by the corresponding (lower cases) variables.

14See Kvart (2001, 2004) for detailed criticisms of Lewis’s analysis of cause. The longer term project I do not have the space to pursue here is to offer a definition of Davidson’s predicate cause used in section § 4 in terms of Kvart’s approach.
Kvart illustrates ex-post-facto probability increase despite ab-initio probability decrease through an example similar to (15b) in a context such as the following. The Comeback Team had been weak for a long time, with few chances of improving during the next months. Nevertheless, Sascha bets a large portion of her financial worth on its winning (cS). Later but before the games start, a wealthy Hungarian start-upper bought the team, and acquired first-rate Belgian players. As a result, the team’s performance was the best ever in the season (cI). Sascha won her bet, and o occurred—she improved her financial position. In this scenario, at the time of cS, cS yielded a probability decrease of o (since betting a lot of money on a weak team amounts to a waste of money). But given cI, cS ultimately yielded a higher chance of o.

Case 2. Suppose now that ab-initio probability increase condition (14) obtains. For instance, in our previous lighthouse scenario (8), cS (the earthquake) is a probability increaser for o (the lighthouse’s destruction). Kvart’s proposal is that in order to check whether cS is a cause of o, we need to check in the intermediate history between cS and o if there is an intermediate event cI such that, if taken into account in the condition on both sides, reverses the inequality in (14), as in (16):

\[ P(O|C_S.C_I.W_{C_S}) < P(O|\neg C_S.C_I.W_{C_S}) \]

If there is no such cI (that is, if the condition (16) does not obtain for any intermediate event), then ex-post-facto probability increase obtains, and cS is a stable increaser; cS can then be a cause of o.\(^\text{15}\) In the lighthouse scenario (8), there is indeed no such decreaser. The event cS can therefore be a cause of o, which corresponds to the intuition.\(^\text{16}\)

Recall that the lexical causative statement (8a) is not felicitous in the lighthouse scenario. This confirms previous observations that the fact that cS is a cause of o does not suffice to make the lexical causative acceptable in a default context (i.e. in absence of adverbials like ultimately, etc., see section 1). I will argue below that cS must be a sufficient ab-initio cause of o for the lexical causative to be acceptable in a default context.

Case 3. Suppose again that (14) obtains but that there is a neutralizer intermediate event cI, i.e. an event for which the condition (17) obtains:

\[ P(O|C_S.C_I.W_{C_S}) = P(O|\neg C_S.C_I.W_{C_S}) \]

Imagine for instance that after the earthquake (cS), the city attributes funding to Mary because of the lighthouse’s historical and artistic value. The lighthouse is fully and extensively renovated (cI). (Nevertheless, Mary’s former husband intentionally burned it down for the insurance money and

\(^{15}\text{Cf. Kvart’s (2001) THESIS 2: If (14) obtains, and (16) does not obtain for any intermediate event, then the requisite ex-post-facto probability increase obtains, and thus cS is a cause of o (numbers and variables mine).}\)

\(^\text{16}\text{As Kvart emphasizes, the existence of a stable increaser is a necessary but not sufficient condition for something’s being a cause (see in particular Kvart 2004: section 3). cS must also be causally relevant to o. This happens if there is no intermediate event that neutralizes the potential causal relevance of cS to o. See Case 3 below for the definition of neutralizers.}\)
it gets completely destroyed ($o$.) In this variant of the lighthouse scenario, the full renovation $c_I$ ‘screens off’ $c_S$ from $o$; that is, the earthquake $c_S$ loses its ab-initio causal impact on $o$ ex-post-facto. The event $c_S$ is not a cause of $o$, despite being an ab-initio probability increaser for $o$. This, again, corresponds to the intuition. Similarly, imagine in the lighthouse scenario that the storms in themselves were strong enough to destroy the lighthouse. Again, the earthquake loses its ab-initio causal impact on $o$ ex-post-facto, and is not a cause for $o$.

In sum, for $c_S$ to be a cause of $o$, it must have a stable increaser, and there should be no neutralizing intermediate event. Kvart (2001, 2004) discusses a number of additional cases to which I cannot do justice here. But I hope that this brief presentation showed how causal relations between events depend on the way in which probabilities evolve with time, and that the notion of ‘some ab-initio positive causal impact’ has to be distinguished from the notion of ‘overall ex-post-facto positive causal impact’.

In the course of the linguistic analysis, I firstly argue that lexical causative statements by default trigger the implicature that $c_S$ is a sufficient ab-initio cause of $o$ given the world history $W_{C_S}$ up to $c_S$. In other words, they by default imply that it is already clear from the ab initio perspective that $c_S$ suffices to trigger the outcome $o$. Secondly, I claim that the constructions which increase the acceptability of the indirect use of lexical causatives, like en fin de compte/finalement ‘ultimately, eventually’ or finir par ‘end up, manage to’, or the clefting of the subject, all cancel this default inference (i.e., indicate that $c_S$ is not a sufficient ab-initio cause of $o$), and convey that $c_S$’s causal impact is considered from a retrospective —ex-post-facto—perspective, once the intermediate history between $c_S$ and $o$ is taken into account.\(^{17}\)

3.3. The inference of directness of lexical causative verbs

Let me now outline the main ingredients of the analysis. Firstly, I propose to redefine the linguistically relevant notion of causal directness through ab-initio sufficiency.\(^{18}\) That is, causal directness is satisfied when (18) below obtains. The condition (18) is satisfied if, given the world history $W_{C_S}$ immediately before $c_S$, the probability of $O$ given $C_S = 1$ at $t'$, the right temporal boundary of $c_S$.\(^{19}\)

\(^{17}\)The difference between the ab-initio and ex-post-facto causal impact of the event involving the subject’s referent is also crucial to account for the fact that the so-called ‘zero-change of state’ reading of causative predicates is easier to obtain with agentive than with non-agentive subjects (see Martin 2015 and references therein): agentive subjects help to adopt the ab-initio perspective, while non-agentive ones often impose the ex-post-facto perspective.

\(^{18}\)Lauer (2010: 21) already suggests that the inference of directness of lexical causatives (that he analyses as an implication rather than an implicature) may result from the fact that these predicates express causal sufficiency as well as causal necessity (as he puts it, ‘a cause that is both necessary and sufficient cannot be very far from its effect’). Here, I do not commit to the view that lexical causatives express causal necessity.

\(^{19}\)Note the condition (18) can be satisfied although $c_S$ is not a cause of $o$. This is where scenarios of causal overdetermination or preemption are relevant. For instance, Mandel (2003) ran an experiment involving a story in which the protagonist is first lethally poisoned, but then intentionally killed in a car accident, before the poison could yield its certain outcome. In this scenario, the administration of the poison ab-initio increases the probability of death to 1, but is not judged a cause of the death by the subjects tested. Therefore, causal directness is not reduced to the condition (18). Rather, (18) defines what has to be the case for $c_S$ to be a direct cause of $o$, while it is independently established...
Secondly, I propose that in absence of information to the contrary, lexical causative statements trigger a defeasible inference (rather than an entailment) that causal directness (18) is satisfied. That is, in a default context, lexical causative statements require the event involving the subject’s referent $c_S$ to be a sufficient ab-initio cause for $o$, regardless of what happens between $c_S$ and $o$ (this is the ab-initio requirement). Without entering into the details, I assume that this inference is obtained via a Gricean reasoning through the competition of lexical causatives with the corresponding periphrastic causatives (e.g. cause/make), which I suspect to strongly imply, and perhaps presuppose, that directness as I propose to redefine it through (18) is not satisfied, since they often involve an intervening causer with a causal contribution to $o$ not automatically triggered by $c_S$.20

The inference of directness as defined through (18) accounts for previous observations on the distribution of lexical causatives. Firstly, it accounts for the recurrent claim that lexical causatives involve something like physical manipulation of the object’s referent by the subject’s referent $S$. For the condition (18) is more likely to be satisfied when $S$ physically acts on the object’s referent than when the object’s referent is a full agent that $S$ incites to act: in the former case, but not the latter, $c_S$ can be conceived as a sufficient cause for $o$ in the epistemic context up to $t'$. Take for instance the sharp contrast in (19), due to Ruwet (1972: 139).

(19) a. Delphine a fait entrer/a entré la voiture dans la garage.
   ‘Delphine made enter/entered the car in the garage.’
   b. Delphine a fait entrer/# a entré les invités dans le salon.
   ‘Delphine made/let enter/#entered the guests in the living room.’

Given the world history $W_{c_S}$ immediately before $c_S$, it is easy to conceive Delphine’s action on/with the car as a sufficient cause for the car’s change of location, while it is odd to conceive Delphine’s incentive to enter as a sufficient cause for the guest’s change of location. This accounts for the fact that the lexical causative is felicitous in (19a) only (and note that the lexical causative in (19b) gets fine if the guests are in wheelchairs that they cannot drive themselves).

Secondly, the same condition (18) is also more easily satisfied if $c_S$ and $o$ are temporally adjacent or partly overlapping, for then, that $o$ obtains given that $c_S$ obtains can more easily be assessed regardless of the intermediate history, since the intermediate history is by definition empty in this case. This may explain the recurrent claim that lexical causatives require something like temporal adjacency between cause and effect.

that $c_S$ is a cause of $o$. This, as Kvart argues, requires ex-post-facto probability increase, which is not obtained in presence of a neutralizer such as the car accident in the scenario above.

20I owe to J.-P. Koenig the suggestion that directness is implied rather than entailed by lexical causatives. The competition between lexical and periphrastic causatives (addressed e.g. in Benz 2006) is out of the scope of this paper. A standardly overlooked difference between lexical causative statements and faire/make-statements is that with an agentive subject, the latter are not implicative; e.g. J’ai fait lire ton papier par les étudiants ‘I made the students read your paper’ does not entail (but rather strongly implies) that the students read your paper, while La curiosité a fait lire ton papier par les étudiants ‘Curiosity made the students read your paper’ does.
However, the condition (18) can also be satisfied when $c_S$ and $o$ are temporally disjoint. Lee Oswald shot John Kennedy on November 22, 1963 at 12.30, and Kennedy died at 13.00 the same day. But a bullet reached and crossed Kennedy’s brain during the gunfire; his death was therefore certain before it actually took place (ignoring major violations of the laws of nature).

Thirdly, (18) is more easily satisfied with an intentional than with an accidental agent (such as the gunsmith in Katz’s original scenario), because, as Copley (2018: fn. 5) underlines, causation associated with intention is robust: an intentional agent can adapt to changes in the environment in order for his chain of actions to be a sufficient cause for the intended outcome $o$. This contributes to explain Neeleman and Van de Koot’s (2012) previous observation that lexical causatives are more acceptable in contexts where temporal adjacency is violated when the subject’s referent is an intentional agent.

Fourthly, we expect subjects to vary in the way they judge lexical causatives to be acceptable under the indirect reading, since the same variation is observed with other types of true but pragmatically infelicitous statements (Noveck 2001 a.o). Subjects more sensitive to the inference of directness (18) are expected to be reluctant to endorse a lexical causative statement when (18) is not satisfied. For instance, the gun’s repair by the gunsmith is not an ab-initio cause of the sheriff’s death $o$ (i.e., (14) is not satisfied as the gun’s repair is not a probability increaser for $o$ up to $t'$), and a fortiori not a sufficient ab-initio cause for it. Therefore, we expect the lexical causative statement (2b) to be rejected by these speakers sensitive to the inference of directness. In the lighthouse scenario (8), the earthquake is an ab-initio cause of the lighthouse’s destruction, but not a sufficient one (i.e., $P(O|C_S,W_{C_S}) \neq 1$); we therefore also expect some speakers to reject (8b) in this scenario. Finally, Danlos’s and Levin and Rappaport’s examples (4)/(5) leave open the possibility that (18) is satisfied, since it may be that the shooting (or the poisoning) was an ab-initio-sufficient-cause of death. These examples are therefore expected not to raise a difficulty.

Fifthly, we also expect lexical causatives to be judged inappropriate by subjects more sensitive to the implicature in a context making clear that $c_S$ cannot raise the probability of $o$ to 1 regardless of what happens in the intermediate history between $c_S$ and $o$. This is the case in the example (20a).

\[(20) \quad a. \quad \text{Paul killed Ana \#by forcing Sue to shoot her.} \quad \text{(inspired from Jackendoff 1972)} \\
\quad b. \quad \#La presse lui \ a \ donné \ le \ prix \ Nobel. \quad \text{\small The press has given the prize Nobel} \]

In a default context, the by-clause in this example strongly suggests that Paul’s action was not sufficient for Ana’s death $o$; Sue also contributed to $o$ in a crucial way.\textsuperscript{21} Similarly, (20b) is weird, because the press coverage is not easily conceived as a sufficient cause for a Nobel Prize’s attribution to an author.

\textsuperscript{21}And note that in a context such that Paul physically forces Sue to shoot Ana, so that $c_S$ is more likely to be a sufficient ab-initio cause for $o$, the acceptability of (20a) increases.
3.4. Cancelling the inference of directness

The inference of directness triggered by lexical causatives is, however, cancellable. I argue below that the linguistic constructions that facilitate the use of lexical causatives in the indirect reading—
the adverbials en fin de compte/ au bout du compte ‘ultimately, eventually’, the implicative verb finir par ‘end up, manage to’—do so because they indicate that (18) is not fulfilled.²² That is, these elements all convey that $c_S$ is not a sufficient ab-initio cause for $o$ in the epistemic context up to $t'$ (the right temporal boundary of $c_S$), and that the causal impact of $c_S$ on $o$ is established from a retrospective perspective only, while the intermediate history between $c_S$ and $o$ is taken into account. I will call these constructions markers of delayed causation. Since, by assumption, the violation of the directness inference is the reason why lexical causatives are unacceptable in indirect causation contexts, the problem vanishes when this inference normally associated with lexical causatives is not triggered or is cancelled. Hence the fact that markers of delayed causation make the indirect reading of lexical causatives acceptable.

Let us first look more closely at causative statements of the form ‘en fin de compte/ au bout du compte $P$/ finir par $P$’ ‘ultimately $P$, eventually $P$’ (insightfully paraphrased as $P$ after a series of other things are taken into consideration by the Merriam Webster dictionary). In such statements, markers of delayed causation may have high or low scope, i.e. have either the whole causal chain on their scope, including the event involving the subject’s referent, see (21a), or the causation event only, see (21b). When they help to license the indirect reading of lexical causatives, markers of delayed causation have their low scope reading.

(21) The executioner ultimately killed the prisoner.
   a. After a series of events the executioner performed his job. (high scope)
   b. After a series of events the executioner’s job caused the prisoner’s death. (low scope)

I argue that these markers contribute in two crucial ways to the lexical causative statement that contains them. Firstly, such lexical causative statements imply that $c_S$ with an intermediate event $c_i$ are together jointly sufficient for $o$, see (22a). For instance, (22b) implies that the operation together with an intermediate event (e.g. subsequent complications) cause the dog’s death.²³

²²Lauer and Nadathur (2017: §3.2) relatedly propose that adverbials such as ultimately can shift what they call the evaluation time of periphrastic causative statements. They propose that this time is by default the time of the cause, which may correspond to the proposal made here that lexical causative statements are by default interpreted as ab-initio causal statements.

²³This inference does not seem to be part of the assertive content of finir par $P$ ‘ultimately $P$’, for denials do not seem to be able to target it, as suggested by the infelicity of the following dialogue:

i. A. This operation ultimately killed the dog. ii. #B. It’s not true; it killed the dog right away—this vet is a true butcher!

Also telling is the fact that ultimately or eventually are not felicitous in the post-verbal position (cf. ?This operation
Secondly and relatedly, such lexical causative statements imply that $c_S$ is not a sufficient ab-initio cause for $o$, cf. (23). Statements of this type are compatible with situations where $c_S$ is either an ab-initio probability decreaser for $o$ (cf. e.g. the default interpretation of (22b)), or an ab-initio probability increaser for $o$ (although to a degree strictly inferior to 1), or neither of the two (i.e. when $P(O|C_S,W_C) = P(O|\neg C_S,W_C)$).

(23) $P(O|C_S,W_C) < 1$  

Given their contributions (22a) and (23), markers of delayed causation are infelicitous when the action of the subject’s referent is clearly a sufficient ab-initio cause for the outcome $o$, see (24).

(24) a. The executioner beheaded the prisoner. He (#ultimately/#eventually) killed him! 
   b. John pressed the button on the automatic door. He (#ultimately/#eventually) opened it!

Markers of delayed causation are not the only way to neutralize the inference of causal directness, however. This inference, which is problematic for the indirect reading, is not triggered in the first place in a context where the causal role of intermediate events is already presupposed. Remember for instance the example (11) repeated below.

(11) We made a couple of front pages on Mahomet in forty years of Charlie’s history, and this is what has been put to the fore by the media, and this is what killed our friends.

In the context of the lexical causative statement (11) (taken from an interview with the caricaturist of Charlie Hebdo), the attack of January 7 2015 is taken for granted, as well as all other putative causes of the killing of Charlie Hebdo’s team, and the killing event itself via the clefting of the subject. It is therefore from the beginning clear that the front page is not a sufficient ab-initio cause of $o$. Similarly, compare (20b) with its variant (25) below:

(25) C’est vrai, il a écrit un bon livre et le jury lui était très favorable. It is true he has written a good book and the committee was very in favour 
Mai en fin de compte, c’est la presse qui lui a donné le prix Nobel. But at the end of the day it is the press that him has given the prize Nobel 
‘True, he wrote a good book and the committee was very in his favour. But at the end of the day, it is the press coverage that gave him the Nobel Prize.’

On that respect, markers of delayed causation share striking similarities with manage to $P$ as described by Baglini and Francez (2016), as reflected by the oddity of manage to open in the same contexts (see their ex. (27)).
The example (25) is much more acceptable than (20b) because in the context of the lexical causative statement of (25), it is presupposed that the press coverage is not a sufficient cause for o. Again, the problematic inference of directness is neutralized. More generally, the clefting of the subject systematically facilitates the indirect reading because it presupposes the occurrence of the outcome o, and suggests that other causes of o have been identified by making alternatives salient in discourse. This indicates that the causal relation is considered from a bird’s eye view, with the intermediate history between cS and o unrolled, rather than from an ab-initio point of view.

Finally, when the subject of the lexical causative refers to an event, the event description within the subject may also contribute to defeat the inference of directness. For instance in (3b), the event description ‘the gunsmith’s negligence’ suggests by itself that all what happens between the gunsmith’s repair and the sheriff’s death is known in the context of the causative statement. It is therefore again clear from the start that cS is not an ab-initio cause for o. Therefore, the inference of directness is cancelled (or not triggered in the first place).25

4. The constraint on separate adverbial modification

Let us now turn to the questions of when and why separate adverbial modification is possible. I argue that we have to empirically distinguish between two different cases, namely, (i) separate modification of an event e involving the subject’s referent (e.g. a shooting) and an event e′ causing a result state of the type encoded by the predicate (e.g. a killing event in the case of kill), such that e causes e′, and (ii) separate modification of a causing event e′ (e.g. a killing event) and the ensuing caused state s (e.g. a state of being dead).

4.1. Separate modification of shooting events and killing events

I take the sentences in (6) repeated below to illustrate that separate modification of the first subtype is possible with eventuality-denoting subjects, but not with entity-denoting subjects.

(6) a. Fred accidentally shot his dog on December 23! He eventually killed him on Dec. 25.
    b. Fred accidentally shot his dog on December 23! This gunshot eventually killed him on December 25.

The eventuality predicate kill Fido is analysed as the bi-eventive predicate (26a), following, e.g., Schäfer (2008). We do not want to account for the unacceptability of (6a) by assuming that the causal relation between the shooting and the killing can only have temporally adjacent eventualities as relata, since we just argued at length in previous sections that cause can relate temporally distant eventualities. Rather, the problem of (6a) is a direct consequence of the fact that the adverbial must

25 Note that with individual-denoting subjects too, the ex-post-facto perspective can be adopted through another element of the context, such as a by-phrase (cf. e.g. (13b)). Therefore, although event-denoting subjects in principle help to make the indirect reading felicitous, they are not necessary for this reading to obtain.
scope on the causing event introduced by the lexical causative verb. The (standard) denotation of
the adverbial on December 25 in (6) given in (26b) ensures this, see (26c), which gives the result
of the composition of (26b) with (26a).²⁶

(26) a. kill Fido \(\sim \lambda e.\exists s(\text{cause}(e, s) \land \text{dead}(s) \land \text{theme}(s, fido))\)
b. on December 25 \(\sim \lambda P\lambda e. P(e) \land \tau(e) \subseteq \text{dec. 25}\)
c. on December 25[kill Fido] \(\sim [\lambda P\lambda e. P(e) \land \tau(e) \subseteq \text{dec. 25}]\)

\(\lambda e.\exists s(\text{cause}(e, s) \land \text{dead}(s) \land \text{theme}(s, fido)) = \lambda e.\exists s(\text{cause}(e, s) \land \text{dead}(s) \land \text{theme}(s, fido) \land \tau(e) \subseteq \text{dec. 25})\)

With an entity-denoting subject, the verbal predicate (26c) is combined with a Voice head (Kratzer
1996) that introduces an external argument \(x\) that is an event or a state, and such that \(x\) is the agent of \(e\), see
(27a). (And note that \(x\) may either act intentionally, or be an accidental agent, as in (9)). Applying
(27a) to (26c), we obtain the verbal predicate (27b).

(27) a. Voice\(_{ag}\) \(\sim \lambda P\lambda x\lambda e. \text{agent}(e, x) \land P(e)\)
b. Voice\(_{ag}\) [on December 25[kill Fido]] \(\sim [\lambda P\lambda x\lambda e. \text{agent}(e, x) \land P(e)]\)

\(\lambda e.\exists s(\text{cause}(e, s) \land \text{dead}(s) \land \text{theme}(s, fido) \land \tau(e) \subseteq \text{dec. 25}) = \lambda x\lambda e.\exists s(\text{agent}(e, x) \land \text{cause}(e, s) \land \text{dead}(s) \land \text{theme}(s, fido) \land \tau(e) \subseteq \text{dec. 25})\)

This obviously accounts for why sentence (6a) is contradictory: given that (27b) requires \(x\) to
perform on December 25 an event causing a state of being dead, there is no room left to identify
this causing event with a previous action of \(x\) taking place on December 23.

But then, what happens in (6b)? Pykkänen (2008) assumes that event-denoting subjects are intro-
duced by another Voice head, that identifies the event introduced by the subject \(e\) (e.g., the gunshot
in (6b)) and the causing event introduced by the verb (e.g., the killing event in (6b)). If such a head
was involved in the semantic composition of (6b), this sentence should be contradictory, given that
the gunshot would have to take place both on December 23 and December 25. We therefore need
another functional element than Pykkänen’s (2008) Voice. This head, that I will call Cause, is in
charge of introducing an external argument \(v\) that is an event or a state,²⁷ and a causing relation
between \(v\) and the causing event \(e\) introduced by the verbal predicate the head combines with,
see (28a). Applying (28a) to (26c), we obtain the verbal predicate (28b), involving three different
eventualities (and two causal relations).

(28) a. Cause \(\sim \lambda P\lambda v\lambda \text{event}(v) \lor \text{state}(v) \land \text{cause}(v, e) \land P(e)\)
b. Cause[on December 25[kill Fido]] \(\sim [\lambda P\lambda v\lambda \text{event}(v) \lor \text{state}(v) \land \text{cause}(v, e) \land P(e)]\)

²⁶I assume that the adverbia on December 25 provides the Reichenbachian reference time, and that the bare
accomplishment infinitive carries a perfective feature, responsible for the inclusion relation in (26b).
²⁷In some cases as (3a), it seems that the causing eventuality denoted by the subject may be a state, which justifies the
decision to leave the nature of the eventuality introduced by the subject unspecified.
Let us now apply the predicate in (28b) to the definite event description \( v.\text{gunshot}(v) \), and derive the predicate in (29a), where the alternative that \( v \) is a state is eliminated:

\[
\lambda e.\exists s (\text{cause}(e, s) \land \text{dead}(s) \land \text{theme}(s, \text{fido}) \land \tau(e) \subseteq \text{dec. 25}) = \\
\lambda \forall e.\exists s (\text{event}(v) \lor \text{state}(v) \land \text{cause}(v, e) \land \\
\text{cause}(e, s) \land \text{dead}(s) \land \text{theme}(s, \text{fido}) \land \tau(e) \subseteq \text{dec. 25})
\]

(29) a. The gunshot[\text{Cause[On December 25[\text{kill Fido}]]}] \rightarrow \\
\lambda e.\exists s (\text{cause}(v.\text{gunshot}(v), e) \land \text{event}(v) \lor \text{state}(v) \land \text{cause}(e, s) \land \\
\text{dead}(s) \land \text{theme}(s, \text{fido}) \land \tau(e) \subseteq \text{dec. 25})

b. Le coup de poignard d’hier a fini par le tuer ce matin.
the stabbing of yesterday has finished by him kill this morning
‘Yesterday’s stabbing eventually killed him this morning.’

We can now understand why sentence (6b) is acceptable. Given that the eventuality \( v \) denoted by the subject \text{causes} the killing event \( e \) denoted by the verb (rather than being identified with it), \( v \) may, of course, take place before the event \( e \) that must take place on December 25, e.g. on December 23. And observe that it is possible to add a temporal modifier within the subject DP that refers to a time different from the modifier applying to the VP, see (29b).

4.2. Separate modification of killing events and caused states of being dead

So far, we thus have accounted for the contrast between (6a) and (6b). The careful reader, however, will have noted that our representation of \text{kill Fido on December 25} in (26c) leaves open the possibility that the caused state of being dead \( s \) occurs after the time interval defined by the adverbial \text{on December 25}. For \( s \) is not in the scope of this adverbial, and by assumption, \text{cause} can relate temporally distant events. Therefore, (26c) predicts that a causative lexical statement such as \text{Fred killed Fido on December 25} can be true in situations where Fido dies after December 25. At this point, I am unsure whether this result is unwelcome or not. The oddity of the example (30a), which slightly modifies (4), suggests that it is. But (30b) is accepted by some speakers I consulted, which points to the possibility that the oddity of (30a) is not of a semantic nature. Also, one finds natural examples such as (30c), locating a killing event in the past, and death in the future.

(30) a. Fred \text{killed} Masha \text{on Sunday}. #She (ultimately) \text{died} on Monday.

b. Lee Oswald \text{killed} President Kennedy \text{on November 22 1963 at 12.30}. He shot him as Kennedy rode in a motorcade through Dealey Plaza in downtown Dallas. Kennedy \text{died} at 13.00 at Parkland Memorial Hospital, where he was rushed after the shooting.

c. Already \text{killed}, but not \text{dead} yet.

If the examples in (30) turn out to be semantically acceptable despite some pragmatic anomalies for (30a), we can stick with (26c). Now, if examples in (30) turn out to be semantically anomalous
because they violate the requirement that the causing event and the result state be in the scope of the temporal adverbial, we have to revise our semantics for kill in order to capture this requirement. One possibility suggested to me by C. Piñón (p.c.) is to include the caused state of being dead in the denotation of kill, and analyze kill Fido (on December 25) as in (31a-c).28

\[(31)\]
\[a. \text{ kill Fido } \sim \lambda v. \exists e \exists s (v = (e \oplus s) \land \text{cause}(e,s) \land \text{dead}(s) \land \text{theme}(s,fido))\]
\[b. \text{ on December 25 } \sim \lambda P \lambda v. P(v) \land \tau(v) \subseteq \text{dec. 25}\]
\[c. \text{ on December 25}[\text{kill Fido}] \sim [\lambda P \lambda v. P(v) \land \tau(v) \subseteq \text{dec. 25}]\]

This predicts examples such as (30) to be contradictory (and we can still account for (6a) vs. (6b) as before, via the Voice alternation). The price is that the sum \((e \oplus s)\) is not an eventuality in the usual sense. However, (31) captures the intuition that kill Fido denotes events and states.

4.3. A final note on causative psych-verbs

An intriguing property of causative psych-verbs is that they differ from non-psych verbs in that they allow for separate adverbial modification even with entity-denoting subjects, see (6a) vs. (32).

\[(32)\] Masha’s speech on Monk’s music on December 23 was quite something. And today she/it gave me the idea I needed for my term paper on phonotactic patterns! (uttered on Dec 25)

What is remarkable about (32) is that it is possible to identify Masha’s speech on December 23 as the single one of her actions causing me to get the idea I needed for my paper (on December 25), and this even in presence of an individual-denoting subject. I claim that this specificity of psych-verbs is due to the fact that their individual-denoting subjects may be reinterpreted as covert event descriptions. Technically, this translates in the view that with these verbs, subjects like Masha may either be introduced by the Voice head (27a), or by the Cause head (28a).

References

28See Rothstein 2004: 35 for an analysis of another subclass of accomplishments in terms of event sums (Rothstein, however, does not address standard causative predicates such as kill). A second possibility would be to analyze kill Fido in the general spirit of Piñón (2011), i.e. as predicates of event pairs \(e,s\) (i.e. analyse kill Fido as follows: \(\lambda (e,s). \text{cause}(e,s) \land \text{dead}(s) \land \text{theme}(s,fido))\).


On competing degree morphemes in verbs of change in Southern Aymara

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Abstract. In this paper, I address verbal predicates of change in Southern Aymara, an understudied Andean language. I concentrate on verbs that are derived with the suffix -cha. This suffix derives degree achievements and creation predicates. I propose that they should be analyzed uniformly as degree achievements. The main empirical point of this paper is that there are two degree morphemes that combine with verbs with -cha, namely, a covert positive morpheme v.POS and an overt suffix -su. The latter is a degree morpheme that restricts the standard of comparison to lexical or contextual maximal degrees. I propose an analysis in terms of Maximize Presupposition: v.POS and -su constitute lexical alternatives where the latter is preferred over the former when maximal values are reached. v.POS is thus felicitous when no maximum is reached. The discussion bears on how telicity is achieved cross-linguistically when degree achievements are considered, thus enriching our typologies on the topic.

Keywords: degree achievement, creation predicate, telicity, Maximize Presupposition, Aymara.

1. Introduction

This paper addresses the compositional semantics of morphologically derived verbs of change in Southern Aymara (henceforth, Aymara). Aymara is an understudied Andean language spoken in southern Peru, Bolivia and northern Chile. Typologically, Aymara is a suffixal and to some extent agglutinative language whose sentences have an SOV order. In particular, I concentrate on the the Peruvian variety of the town of Pomata (province of Chicuito, department of Puno) that is spoken by 13,637 people (Instituto Nacional de Estadística e Informática, 2010).

In particular, I concentrate on verbal predicates of change that are derived by means of the suffix -cha. This suffix derives two kinds of predicates, i.e., degree achievements and creation predicates, as shown in the examples in (1) and (2) respectively:

1 I would like to especially thank Jon Gajewski for extensive discussion on this topic. His constant feedback has been invaluable in the development of this project. I would also like to thank Roger Gonzalo Segura for discussing particular points of the Aymara grammar with me, in particular, for clarifying several aspects of what the sentences included in this paper may or may not mean. I would also like to thank Magda Kaufmann, Stefan Kaufmann and Jonathan Bobaljik for comments on previous drafts. Many ideas that I adopted in the end are the result of their feedback. Thanks also to Karlos Arregi, Itamar Francez, Chris Kennedy, Angelika Kratzer, Manfred Krifka and Lisa Matthewson for discussion and suggestions at different stages of the project. This work was supported by NSF IGERT DGE-1144399 to the University of Connecticut, the University of Connecticut’s CT IBACS 2016 and the University of Connecticut’s El Instituto’s Tinker Award 2016-2017.
2 Abbreviations: 3 = third person, ABL = ablative, ACC = accusative, EVI = evidential, S = subject, TOP = topic.
3 I put elided vowels in parentheses.
4 I translate the examples in the past, as this is the default way native speakers understand the sentences I discuss (Aymara does not distinguish present and past). In addition, in Aymara, there are no determiners, so bare nouns could be understood as definite or indefinite. In what follows, all the arguments (subjects and objects) should be understood as singular and definite (for this reason, I glossed them with the definite determiner). I leave aside the contribution of the so-called evidential -wa.

The sentences in (1) illustrate degree achievements with -cha with the verbs llusk’a-cha-ña ‘to straighten’ and qañu-cha-ña ‘to dirty’ (the suffix -ña is the infinitival marker). Both sentences are similar to their English counterparts in the glosses in that they mean that the theme increases in their degree along the scale associated with the base predicates, i.e., the scale of straightness and dirtiness in the examples. In addition, -cha derives verbs creation predicates like thaki-cha-ña ‘to build (path-like things)’ in (2). This sentence means that an object, here a path, comes into existence. In this paper, I provide evidence that suggests that these two different kinds of verbal predicates should be analyzed in the same way in the Aymara case under discussion. Specifically, I argue that they should be analyzed as degree achievements in the sense of Kennedy and Levin (2008), i.e., in terms of an increase along a scale.

The main contribution of this paper regards how telicity contrasts are achieved in expressions including verbs with -cha. For instance, the English translation in (1a) and (2) have a default telic reading. (1a) has a default absolute reading in which a culmination is reached, i.e., the theme is straightened to its maximum (= a maximal degree of straightness is reached), so telic adverbials are preferred over atelic ones. The same can be said with regard to (2): this sentence has a default reading in which the building of the theme reaches a point in which it is fully built, so the distribution of adverbials is the same as for (1a). (1b), on the other hand, shows a different behavior: since the scale of dirtiness does not have a lexical maximum, culmination is not implied, which further means that atelic adverbials are preferred over telic ones.

Aymara is different in this regard. The sentences in (1) and (2) behave identically in that they are all understood in terms of the lack of a culmination, so atelic adverbials are preferred over telic ones. For a culmination to be reached, another suffix needs to be attached. This suffix is -su. The sentences in (1) and (2) are repeated below including -su now. In this case, then, telic adverbials are acceptable, but atelic ones are not. In other words, telicity contrasts in Aymara verbs derived with -cha depend on the presence or absence of -su.

(3) a. Mariya ñik’ut(a)-Ø llusk’a-ch(a)-su-(i)-wa.
   Mariya hair-ACC straight-ch(a)-su-3S-EVI
   ‘Mary straightened the hair (to a lexical maximal degree).’

   b. Mariya mis(a)-Ø qañu-ch(a)-su-(i)-wa.
   Mary table-ACC dirty-ch(a)-su-3S-EVI
   ‘Mary dirtied the table (to a contextual maximal degree).’
I propose an analysis in terms of Maximize Presupposition Heim (1991): assuming Kennedy and Levin’s (2008) account of degree achievements, I argue that Aymara has two degree morphemes, a covert verbal positive morpheme v.POS and -su, which are lexical alternatives. -su restricts the standard to maximal values; v.POS shows no restrictions in this regard. Since -su has a restricted domain, it is preferred over v.POS whenever a maximum is reached. This derives the contrast in telicity between Aymara and English, which in turn enriches our typologies regarding how telicity is achieved cross-linguistically. I thus provide evidence from Aymara for a so far unattested two degree morpheme system in connection with scalar verbs of change.

The data discussed in this paper are based on two sources of information: grammatical descriptions, in particular, Cerrón-Palomino (2008) and Gonzalo Segura (2011), and original fieldwork with two consultants. The methodology used for the latter involved the presentation of contextual scenarios using Spanish as an auxiliary language, which was followed by a request for a felicity judgment on a particular grammatical sentence given that contextual scenario. I refer the reader to Bochnak and Matthewson (2015), Davis et al. (2014), Matthewson (2004) for discussion regarding the soundness and validity of the aforementioned methodological choices.

The paper is organized as follows; in section 2, I discuss verbs with -cha, including what base predicates it takes, and why degree achievements and creation predicates should be analyzed in the same way in this case. In section 3, I add -su into the discussion, addressing the telicity contrasts it gives rise to. In section 4, I provide an account of the facts discussed and address the predictions of the analysis. In section 5, I summarize the main points of the discussion.

2. Verbs with -cha

In this section, I address derived verbs with -cha. In subsection 2.1, I discuss the meanings verbs with -cha can have and argue that they should be analyzed uniformly. In subsection 2.2, I discuss what base predicates -cha takes.

2.1. Degree achievements and creation predicates brought together

The suffix -cha derives degree achievements (5) and creation predicates (6). The sentences in (5) mean that the theme uta ‘the house’ increases in the extent to which it is beautified (5a) or strengthened (literally, hardened) (5b). The sentence in (6) means that an object, uta ‘the house’ in this case, comes into existence—the verb uta-cha-ña is thus a creation predicate. This verb is used to mean that any house-like thing is built (e.g., schools, offices, buildings, etc.).

(5) a. Mariya ut(a)-∅ k’ačha/t’ika-ch(a)-i-wa.
    Mary  house-ACC beautiful/ornament-cha-3S-EVI
‘Mary beautified the house.’

b. Jaqi ut(a)-∅ qala-ch(a)-i-wa.
person house-ACC stone/hard-cha-3S-EVI
‘The people strengthened the house.’

(6) Jaqi uka ut(a)-∅ uta-ch(a)-i-wa.
person that house-ACC house-cha-3S-EVI
‘The people built that house.’

The sentences in (5) and (6) further show that -cha takes non-gradable and gradable bases. (5a) includes two derived verbs that mean the same, i.e., ‘beautify’. Their bases are k’acha ‘beautiful’, which is gradable, and t’ika ‘ornament’, which is non-gradable. (5b) includes a derived verb whose base, qala, is ambiguous between a non-gradable version meaning ‘stone’ and a gradable version meaning ‘hard’. The verb with -cha, however, can only mean ‘to harden’. (6) includes a verb derived from the non-gradable base uta ‘house’.

In what follows, I propose that degree achievement readings and creation predicate readings are to be analyzed uniformly when verbs with -cha are considered, specifically, they should be analyzed together as degree achievements (in the sense of Kennedy and Levin 2008; see section 4 for the proposal) involving gradable bases. I provide three pieces of evidence that suggest that a unified analysis should be pursued.

First, both degree achievements and, crucially, creation predicates can be modified by adverbial intensifiers, such as sinti ‘a lot’, sinti-puni ‘too much’ and juk’aki ‘a little’. The claim is that if these modifiers are grammatical, the predicates involved are gradable, in this case, involving a degree achievement-like reading (see Kennedy 2012 for discussion). This is illustrated in (7).

(7) a. Mariya sinti / sinti-puni / juk’aki ut(a)-∅ k’acha/t’ika-ch(a)-i-wa.
Mary a.lot / too.much / a.little house-ACC beautiful/ornament-cha-3S-EVI
‘Mary beautified the house a lot/too much/a little.’

b. Jaqi sinti / sinti-puni / juk’aki uka ut(a)-∅ uta-ch(a)-i-wa.
person a.lot / too.much / a.little that house-ACC house-cha-3S-EVI
‘There was a lot/too much/a little of the people’s building of that house.’
Lit. ‘The people built that house a lot/too much/a little.’

Second, consider the pair of sentences in (5a) with the verbs k’acha-cha-ña and t’ika-cha-ña ‘to beautify’ with gradable k’acha ‘beautiful’ and non-gradable t’ika ‘ornament’ respectively. Interestingly, as suggested by means of the same gloss in the examples, sentences with these verbs appear to have rather similar meanings—in particular, the verb with non-gradable t’ika ‘ornament’ has the marks of property predication, just like the verb with gradable k’acha ‘beautiful’. For instance, they are both felicitous if any improvement that beautifies uta ‘the house’ is made, e.g., by painting it or remodeling it. Note that this is not tied to actually putting ornaments in the theme, which is the literal meaning of t’ika ‘ornament’. Another context in which these verbs can be used is shown in (8), where Susi is made more beautiful, e.g., by getting a new haircut or a new piece of jewelry. Of relevance here is thus the idea of making the theme (more) beautiful—i.e., the degree achievement reading.
Third, consider the sentence in (5b) with the verb *qala-cha-*ña ‘to harden’. The base predicate is the ambiguous *qala* ‘stone, hard’. Interestingly, the verb can only mean ‘to harden’ (not ‘to turn into stones’ or ‘to create stones’). Thus, for instance, (5b), repeated below, is felicitous when the structures of the theme are strengthened, and, crucially, stones need not be involved—any strengthening will make (9) felicitous. In addition, targeting the non-gradable meaning is infelicitous: imagine a context in which a god turns things into stones. In this scenario, a sentence with *qala-cha-*ña ‘to harden’ is infelicitous. This suggests that only the degree achievement reading (i.e., the verb with the gradable base) is available in this case.

(9)  
Jaqi ut(a)-/0 qala-ch(a)-i-wa.  
person-ACC stone/hard-cha-3S-EVI  
‘The people strengthened the house.’

Based on these pieces of evidence, I propose that degree achievements and creation predicates in Aymara should be analyzed uniformly. In particular, in this paper I adopt the view that they should all be analyzed as degree achievements (in the sense of Kennedy and Levin 2008), being derived from a gradable base. I now turn to the distribution of the latter in verbs with *-cha*.

2.2. Base predicates

Following extensive literature on the topic (Cresswell, 1976; Kennedy and McNally, 2005; Klein, 1991; Pedersen, 2015), gradable base predicates can be characterized in terms of scales $S$, which are sets of linearly ordered degrees $d$ along some dimension associated with a base predicate. A scale $S$ is defined as follows:

$$(10) \quad \text{The scale } S \text{ associated with a gradable base predicate is a pairing } \langle S, < \rangle \text{ or } \langle S, > \rangle, $$

where $<$ or $>$ is a linear order on $S$.

The minimal and maximal degrees in the scale $S$ of a gradable base predicate are defined in (11)—note that if $\min$ or $\max$ exists, it is unique (since the scale is linearly ordered):

$$(11) \quad \begin{align*}  
a. \quad & \min, \text{ the minimal degree } \in S, \text{ is defined as the degree } d \text{ such that no degree } d' < d. 

b. \quad & \max, \text{ the maximal degree } \in S, \text{ is defined as the degree } d \text{ such that no degree } d < d'. 
\end{align*}$$

The scale associated with a predicate could have (i) no minimal or maximal degree, i.e., open scales (12a), (ii) either a minimal or a maximal degree, i.e., partially closed scales, as in (12b), or (iii) both a minimal and a maximal degree, i.e., closed scales, as in (12c). (12) illustrates the same dimensions, i.e., beauty in (12a), cleanliness/dirtiness and curliness/straightness (12b), and emptiness/fullness in (12c) but opposite orderings, as indicated in the parentheses next to each item.

$$(12) \quad \begin{align*}  
a. \quad & \text{beauty in } \langle S, < \rangle, 

b. \quad & \text{cleanliness/dirtiness and curliness/straightness in } \langle S, > \rangle, 

\text{and emptiness/fullness in } \langle S, > \rangle \text{ but opposite orderings, as indicated in the parentheses next to each item.} 
\end{align*}$$
Turning now to verbs with -cha, the suffix takes gradable bases with any kind of scale, as shown in (13), i.e., open scales (13a), partially closed scales (13b)-(13c) and closed scales (13d).

(13)  
\begin{align*}
\text{a. } & \text{k'acha 'beautiful' k'acka-cha-ñà 'to beautify'} \\
\text{b. } & \text{q'añu 'dirty' qañu-chà-ñà 'to dirty'} \\
\text{c. } & \text{llusk'a 'straight' llusk'a-cha-ñà 'to straighten'} \\
\text{d. } & \text{phuqa 'full' phuqa-cha-ñà 'to fill'}
\end{align*}

Moreover, as anticipated with regard to (5b)-(9), there is a group of bases for which there is a non-gradable and a gradable version. When the -cha verb is derived, only the gradable version of the base (whose scale is open) is used—as mentioned in subsection 2.1, targeting the non-gradable meaning is infelicitous; only the gradable meaning is available in the derived verb.

(14)  
\begin{align*}
\text{a. } & \text{qala 'stone, hard' qala-cha-ñà 'to harden'} \\
\text{b. } & \text{qamaqi 'fox, witty' qamaqi-chà-ñà 'to become wittier'} \\
\text{c. } & \text{anu 'dog, aggressive' anu-chà-ñà 'to become (more) aggressive'}
\end{align*}

An additional group of bases -cha takes is shown in (15). Here the bases are non-gradable. The verb with -cha, however, does not target the actual meaning of the base, but a property (i.e., a gradable) meaning of it (see Beavers 2011). I assume that the bases are turned into gradable to combine with -cha. Thus, in (15a), the verb with -cha includes a property meaning ‘beautiful’ and, in (15b), it includes a property meaning ‘cultivatedness’.

(15)  
\begin{align*}
\text{a. } & \text{t'i'ka 'ornament' t'i'ka-cha-ñà 'to beautify'} \\
\text{b. } & \text{yapu 'sown field' yapu-cha-ñà 'to cultivate, to grow'}
\end{align*}

In general, the verbs with -cha in (13)-(15) have a degree achievement-like meaning—where a gradable base with a property scale is present.

The last group of bases -cha takes are the ones that derive creation predicates, i.e., they predicate of a theme that it comes into existence. As with regard to (15), here I assume that the bases are non-gradable; when they combine with -cha, they are turned into gradable having an extent scale associated with them (see Beavers 2011). I further assume that these scales are top closed, i.e., there is a maximum corresponding to the actual presence of the entity denoted

\[6\] A general mechanism to turn non-gradable bases into gradable would be needed in this case. This would also be needed for (16) below. I set aside an explicit formulation of this in this paper.

\[7\] In this paper, extent scales are understood as scales involving that an entity comes into existence.
by the base. The theme in these cases has to be somewhat similar to what the base means. Thus, the theme in (16a) has to be house-like (i.e., it must have, say, four walls and a roof), and the theme in (16a) has to be path-like (i.e., it must have, say, a gap perhaps flanked by borders where entities can go through).  

(16) a. uta 'house' uta-cha-ña 'to build (house-like things)'
    b. yapu 'path' yapu-cha-ña 'to build (path-like things)'

To summarize, verbs with -cha derive two kinds of verbs, namely, degree achievements and creation predicates. The bases the suffix takes are both gradable and non-gradable. When taking the former, -cha derives degree achievements; when taking the latter, they are turned into gradable bases and -cha derives degree achievements or creation predicates.

3. Adding -su: telicity contrast

In this section, I discuss how telicity contrasts are achieved in expressions including verbs with -cha. I first discuss telicity in connection with degree achievements in English, which I will use as a baseline in order to address how Aymara differs from it. As previous literature has pointed out with regard to English (see Dowty 1979; Abusch 1986; Winter 2006; Kennedy and Levin 2008), degree achievements like straighten in (17) are ambiguous between an absolute reading, where the theme reaches a maximal degree, namely, that representing a degree corresponding to fully straight—this is the default reading—, and a comparative reading where the theme ends up straighter, which is achieved when additional (e.g., contextual) cues are given:

(17) Mary straightened the hair.

With degree achievements like dirty in (18), on the other hand, the comparative reading is strongly preferred, since the scale associated with the verb does not include an absolute maximal degree (see Winter 2006; Kennedy and Levin 2008 for discussion):

(18) Mary dirtied the table.

This distinction has consequences when adverbial expressions targeting atelic and telic readings are considered. For sentences with verbs like straighten, telic adverbials like in an hour are preferred over atelic ones like for an hour, as shown in the contrast in (19), since the telic adverbial introduces a bound in the event, which is consistent with the presence of a maximal degree—as it constitutes a bound in the scale. This is not the case with atelic adverbials. This is shown in (19). For sentences with verbs like dirty, atelic adverbials are preferred over telic ones, since an atelic adverbial does not target a maximal degree. This is shown in (20).  

---

8I set aside a detailed account of what it means for a creation predicate to be analyzed as a degree achievement. See Beavers (2011), Kennedy (2012), Krifka (1998) and Piñón (2008) for relevant discussion.

9I leave the determination of details of the nature of the scale in (15)-(16) (i.e., whether it is open, partially closed or closed) for future research. I also set aside in what cases a non-gradable base derives a degree achievement or a creation predicate.

10The sentences to follow are conceived of as said out of the blue.
When Aymara degree achievements with -cha are considered, in principle, the expectation would be that they behave as their English counterparts when it comes to the adjunction of (a)telicity adverbial expressions. However, this is not the case. To test (a)telicity, I make use of the telic adverbial mà ura-tha ‘in an hour’ and the atelic adverbial mà ura ‘for an hour’. What distinguishes the adverbials is the ablative suffix -tha, which is present in telic adverbials, but is absent in atelic ones.

To illustrate this, I add the (a)telicity adverbials to the examples in (1) and (2) above, as shown below. What can be readily noticed is that there is no contrast with regard to (a)telicity regardless of the presence or absence of a maximum value in the scales associated with the verbs. In the case of llusk’a-cha-ña ‘to straighten’ in (21), there is a maximum in the scale. In the case of qañu-cha-ña ‘to dirty’ in (22), on the other hand, there is no absolute value on the relevant end in the scale. Despite these differences, which make English degree achievements vary with regard to (a)telicity, as shown in (19)-(20) above, the Aymara examples are consistently marked with the telic adverbial mà ura-tha ‘in an hour’ and consistently good with the atelic adverbial mà ura ‘for an hour’. The same holds in (23) with thaki-cha-ña ‘to build (path-like things)’: regardless of the presence of a maximum in the scale, telic adverbials are bad and atelic ones are good.
For telic adverbials to be grammatical when verbs with \(-cha\) are present, the suffix \(-su\) needs to be added, as shown in (24)-(26). In grammar descriptions of Aymara, this suffix is glossed as ‘completely’ (see Gonzalo Segura 2011). When it is present, the judgements in (21)-(23) are reversed: telic adverbials become grammatical and atelic ones become marginal. Note in the examples that the contrast in judgment is sharp in this case: whenever \(-su\) is present, atelic adverbials become marginal. Again, it is worth emphasizing that all the sentences show the same behavior in terms of (a)telicity regardless of the presence or absence of absolute endpoint values in the scales associated with the verbs under discussion. The main contrast is thus between the presence or absence of \(-su\).

(24) a. Mariya mā ura-tha ŋik’ut(a)-Ø llusk’a-ch(a)-su-(i)-wa.  
   Mary one hour-ABL hair-ACC straight-ch(a)-su-3S-EVI  
   ‘Mary straightened the hair in a hour.’

b. ?Mariya mā ura ŋik’ut(a)-Ø llusk’a-ch(a)-su-(i)-wa.  
   Mary one hour hair-ACC straight-ch(a)-su-3S-EVI  
   ‘Mary straightened the hair for an hour.’

(25) a. Mariya mā ura-tha mis(a)-Ø q’añu-ch(a)-su-(i)-wa.  
   Mary one hour-ABL table-ACC dirty-ch(a)-su-3S-EVI  
   ‘Mary dirtied the table in a hour.’

b. ?Mariya mā ura mis(a)-Ø q’añu-ch(a)-su-(i)-wa.  
   Mary one hour table-ACC dirty-ch(a)-su-3S-EVI  
   ‘Mary dirtied the table for an hour.’

(26) a. Jaqi mā ura-tha uka thak(i)-Ø thaki-ch(a)-su-(i)-wa.  
   person one hour-ABL that path-ACC path-ch(a)-su-3S-EVI  
   ‘The people built that path in an hour.’

b. ?Jaqi mā ura uka thak(i)-Ø thaki-ch(a)-su-(i)-wa.  
   person one hour that path-ACC path-ch(a)-su-3S-EVI  
   ‘The people built that path for an hour.’

This discussion begs the question of what kind of element \(-su\) is. The hypothesis that I pursue in the next section is that it is a degree morpheme that targets maximal degrees.

4. Proposal

In this section, I propose an analysis of verbs with \(-cha\) including the telicity contrasts in connection with the presence or absence of \(-su\). Subsection 4.1 discusses the semantics I assume for verbs with \(-cha\); subsection 4.2 argues that \(-su\) is a degree morpheme; subsection 4.3 is the analysis; subsection 4.4 discusses the predictions of the analysis.

4.1. The semantics of derived verbs with \(-cha\)

To account for the meanings of verbs with \(-cha\) in Aymara, my proposal is similar to Kennedy and Levin’s (2008) account for English, which I briefly summarize below. The authors suggest
that degree achievements denote a differential measure function that measures the amount that an entity changes along a scale associated with a base predicate as a result of participating in an event (see also Hay et al. 1999; Kennedy 2012; Pedersen 2015 for alternative formalizations). The amount mentioned corresponds to the output of the differential measure function, which equals the degree that represents the positive difference between two degrees, namely, the degree to which the theme measures the function denoted by a gradable predicate at the end of an event minus the degree to which the theme measures the function denoted by a gradable predicate at the beginning of the event; this captures the idea that there is an increase in a scale. Degree achievements are always closed on the end of the scale corresponding to this degree, i.e., there is always a derived minimum. For Kennedy and Levin (2008), the differential measure function is derived from ‘regular’ measure functions, i.e., those denoted by gradable predicates $m$—here I assume that gradable bases denote measure functions that map an individual and an event into a degree, where the degree is held constant in the event (Morzycki, 2015). The denotations of ‘regular’ and derived measure functions are shown in (27a) and (27b) respectively (Kennedy and Levin’s 2008:173):

\[(27)\]
\[
a. [m] = \lambda x \lambda e [m(x,e)] \\
b. For any measure function $m$, $m_\Delta = \lambda x \lambda e [m_{\Delta(x,e)}(x,fin(e))]$
\]

I adopt this semantics for verbs with -cha, thus giving a unified semantics to degree achievements and creation predicates. My proposal differs from Kennedy and Levin’s (2008) in that I suggest that, in Aymara, -cha is the lexical item that derives the differential measure function—this follows Hay et al. (1999) and Pedersen (2015), who propose that an (abstract) suffix -en in English derives degree achievements from gradable predicates. This move seems warranted, since -cha systematically derives the verbs under discussion. The denotation of -cha appears in (28). Thus, -cha takes as arguments a measure function $m$ (a gradable predicate), an individual $x$ and an event $e$ and gives a degree that results from the difference of the degree to which $x$ measures $m$ at the end of $e$ minus the degree to which $x$ measures $m$ at the beginning of $e$. In what follows, I use the abbreviated version using $m_\Delta$ in (28b) (this follows Kennedy and Levin’s 2008 convention in their discussion of English).

\[(28)\]
\[
a. [-\text{cha}] = \lambda m \lambda x \lambda e [m_{\Delta(x,e)}(x,fin(e))] \\
b. [-\text{cha}] = \lambda m \lambda x \lambda e [m_{\Delta(x,e)}]
\]

I exemplify the proposal with the examples in (1) and (2), which are repeated in (29):

\[(29)\]
\[
a. \text{Mariya Ńik’ut(a)-Ø llusk’a-\textbf{cha(a)}-i-wa.} \\
\quad \text{Mariya hair-ACC straight-\textbf{cha}-3S-EVI} \\
\quad \text{‘Mary straightened the hair.’}
\]
b. Mariya mis(a)-∅ q’añu-ch(a)-i-wa.
   Mary table-ACC dirty-ch-3S-EVI
   ‘Mary dirtied the table.’

c. Jaqi uka thak(i)-∅ thaki-ch(a)-i-wa.
   person path-ACC path-ch-3S-EVI
   ‘The people built that path.’

Restricting to the relevant part of the VPs under discussion, I assume the LF in (30) for Aymara VPs. This representation does not include degree morphology, which will be discussed in the next subsections.

(30)
Theme
   base predicate -cha

The denotations of the VPs present in (29) appear below:

(31)  
a. [-cha ([llusk’a]) ([ñikuta]) = λe[straight_Δ(hair, e)]

b. [-cha ([qañu]) ([misä]) = λe[dirty_Δ(table, e)]

c. [-cha ([thaki]) ([uka thaki]) = λe[path-build_Δ(that path, e)]

The denotations in (31) make explicit that there is a differential degree. This degree corresponds to the difference of the degree to which the theme measures the function denoted by the gradable base at the end of the event minus the degree to which the theme measures such function at the beginning of the event. In the examples, it is the degree to which the theme was straightened (31a), dirtied (31b) and built (31c)—this captures the idea that there has been an increase along a scale. In the next subsection, I turn to -su’s status as a degree morpheme.

4.2. -su as a degree morpheme

In this subsection, I provide morphosyntactic evidence that suggests that -su is a degree morpheme. The claim is that -su merges very low in the structure, which is the position where degree morphemes are combined. Gonzalo Segura (2011) shows that -su is a suffix that combines very close to the verbal domain, in fact, it appears right next to -cha. It precedes all the morphemes that alter the verbal valence, such as the anticausative -ta and the benefactive -rapi. It also precedes aspectual markers. For instance, the durative -ska, merges after -su—the durative also combines in the structure after the suffixes that alter the valence of the verb are combined. This distribution is consistent with -su being a degree morpheme, since this kind of elements are claimed to combine in a very low position in the structure (Hay et al., 1999; Kennedy and Levin, 2008; Pedersen, 2015).

The relative position of -su and -ska is of particular interest here, since it could be argued that -su is some kind of perfect(ive) aspectual marker, since it is closely tied to telic readings, as discussed in section 3. If -su were an aspectual marker, the prediction would be that these two
suffixes would not co-occur—as they would head the same projection (e.g., AspectP)—, contrary to fact (see Merchant 2015 and references therein for discussion on the relative position of AspectP in the syntactic spine). In this regard, consider the example in (32), in which -su and -ska appear in the same clause. In the example, the duration of the event of Mary dirtying the table is extended, and it ends reaching a point in which it cannot be dirtied anymore. Under the hypothesis that -su targets maximal values, the presence of this suffix in (32) would mean that a (contextual) maximal degree at the end of the event is reached (as the scale associated with the base qaña ‘dirty’ does not include a lexical one). The English translation using the progressive tries to make explicit that the duration of the event was extended.

(32) Mariya mis(a)-∅ qaña-ch(a)-su-sk(a)-i-wa.  
Mary  table-ACC dirty-cha-su-DUR-3S-EVI  
‘Mary was dirtying the table (and reached a contextual maximal degree).’

The sentence when -su is absent is also grammatical, as shown in (33). In this case, the duration of the event is also extended. Crucially, (32) and (33) differ minimally in that a maximal degree is not reached in the latter (since -su is absent). Note that in both sentences the durative’s contribution to the meaning of the sentence is the same: the duration of the event is extended. Crucially, this meaning does not compete with or replace the contribution of -su.

(33) Mariya mis(a)-∅ qaña-cha-sk(a)-i-wa.  
Mary  table-ACC dirty-cha-DUR-3S-EVI  
‘Mary was dirtying the table (and reached a non-maximal degree).’

As anticipated, the relative position of the suffixes in Aymara is consistent with the proposal that -su is a degree morpheme, as it combines in a very low position in the structure (Hay et al., 1999; Kennedy and Levin, 2008; Pedersen, 2015). Based on this, I revise the LF in (30) to include degree morpheme Deg. Note that in (34) it is made explicit that Deg is combined right after the verb is formed.

(34)  
Theme  
base predicate  -cha  Deg  

In the next subsection, I turn to the semantics of -su and discuss its relation to v.POS.

4.3. Semantics of -su and its relation to v.POS

Following Kennedy and Levin (2008) (see also Pedersen 2015) in their account for English, I assume that the role of degree morphology is to turn a measure of change into a property of events. In their account, degree morphology includes a standard function, which represents the minimum degree required to stand out in a given context. Degree morphology is assumed to inherit the scalar properties of the gradable base in degree achievements relative to the kind of
measurement encoded by the gradable base. A degree morpheme is of type $\langle\langle e, sd \rangle, \langle e, st \rangle\rangle$ (I use $s$ for the type of events). In English, the relevant degree morphology is a verbal positive morpheme $v\text{.POS}$, which takes a derived measure of change and turns it into a property of events. Following Kennedy and Levin’s (2008) convention, I use $m_\Delta$ as an abstract representation of derived measures of change; I also use $m_\Delta$ for variables of type $\langle e, sd \rangle$, which is the type of derived measures of change. (35b) says that that application of $[v\text{.POS}]$ to $[m_\Delta]$ yields a function that is true of individual $x$ and event $e$ if and only if the degree of $m_\Delta$ (i.e., the amount to which $x$ changes in $e$) exceeds the minimal value or equals the maximal value of the standard of $m_\Delta$. To implement the assignments of values of the standard function, I propose a contextual variable assignment $g$ that assigns a value to free variables represented with index $i$ of type $d$ such that $g(i)$ is in the domain of $m_\Delta$ (see Barker 2002; Heim 1994; Lewis 1979; Stanley 2000).

(35) a. $[v\text{.POS}]^g = \lambda m_\Delta \lambda x \lambda e [m_\Delta(x,e) \geq g(i)]$
   b. $[v\text{.POS}]^g([m_\Delta]^g) = \lambda x \lambda e [m_\Delta(x,e) \geq g(i)]$

Kennedy and Levin (2008:169) further propose that the value of the standard function is guided by the principle of Interpretive Economy, stated below (this follows Kennedy 2007; see also Pedersen 2015):

(36) Maximize the contribution of the conventional meanings of the elements of a sentence to the computation of its truth conditions.

There are two cases to consider, namely, when the degree achievement’s scale has or does not have a lexical endpoint value—(37) repeats (17) and (18):

(37) a. Mary straightened the hair.
   b. Mary dirtied the table.

If the verb does not include a lexical endpoint value, like with dirty in (37b), there is nothing to maximize, so the value of the standard equals a derived minimum (a derived zero), i.e., the output degree of the measure function applied to the individual at the beginning of the event. Exceeding this minimum accounts for the comparative reading of degree achievements—this reading is available with all the verbs. If the degree achievement’s scale does include a lexical endpoint value, like with straighten in (37a), then conventional meanings are maximized and the standard function equals the lexical maximal value in the scale. Being equal to this standard accounts for the absolute reading of degree achievements—this reading is restricted to those verbs including lexical maximal values. Interpretive Economy in (36) thus accounts for the preference of the latter reading when a degree achievement includes a lexical maximum.

Under my implementation of the standard function in terms of variable assignment $g$, the assignment of minimal or maximal values is stated as follows:

(38) a. If $m_\Delta$ has a (lexical) maximal value $\text{max}$, $g(i) = \text{max}(m_\Delta)$.
   b. If $m_\Delta$ does not have a (lexical) maximal value $\text{max}$, $g(i) = \text{min}(m_\Delta)$. 

On competing degree morphemes in verbs of change in Southern Aymara
The denotations of (37) are as shown below. The value of \( g(i) \) in (39a) follows from (38a) and the value of \( g(i) \) in (39b) follows from (38b).

\[
\begin{align*}
\text{(39) a. } \quad & [(37a)]^g = \lambda e[\text{straight}_\Delta(hair,e) = \max(\text{straight}_\Delta)] \\
\text{b. } \quad & [(37b)]^g = \lambda e[\text{dirty}_\Delta(\text{thetable},e) > \min(\text{dirty}_\Delta)]
\end{align*}
\]

I now turn to Aymara. Recall that I argued in section 4.1 that -cha takes a gradable base denoting a measure function and turns it into a differential differential measure one. The difference between English and Aymara lies in that in the latter there are two verbal degree morphemes, that is, in addition to verbal positive morpheme \( v.\text{POS} \), there is overt -su. In the spirit of Heim (1991) (see also Percus 2006), the suggestion is that the two morphemes constitute lexical alternatives \( \text{LEXALT} \) in competition, as represented in (40). While -su restricts the value of the standard to maximal ones, \( v.\text{POS} \) does not show any restriction, just as the English counterpart in (35a). Under the assumption that the option with a restricted domain is preferred, -su blocks \( v.\text{POS} \) whenever a maximum is available. The denotation of \( v.\text{POS} \) is repeated below for Aymara in (41a) and the denotation of -su appears in (41b). The only difference between the two lies in the domain restriction in -su, where the standard equals a maximal degree. Note that this means that in Aymara Interpretive Economy need not apply in the case of the expressions under discussion, since there are additional lexical means that maximize means.

\[
\begin{align*}
\text{(40) } \quad & \text{LEXALT} = \{v.\text{POS}_i , -su_i\}, \text{ where } -su_i \text{ blocks } v.\text{POS}_i \text{ if } \max(m_\Delta) \text{ in } m_\Delta \text{ is reached.}
\end{align*}
\]

\[
\begin{align*}
\text{(41) a. } \quad & [v.\text{POS}_i] = \lambda m_\Delta \lambda x \lambda e[m_\Delta(x,e) \geq g(i)] \\
\text{b. } \quad & [-su_i] = \lambda m_\Delta : g(i) = \max_i(m_\Delta) \lambda x \lambda e[m_\Delta(x,e) \geq g(i)]
\end{align*}
\]

In terms of what value is assigned to index \( i \), in Aymara, there are three cases to consider. Two of them are similar to those that work for the English case stated in (38): if there is a lexical maximal value in the scale, it will be used (38a) and if there is no lexical maximal value in the scale, the derived minimum is used (38b), with the difference that the latter in Aymara does not show a restriction to the cases where no lexical maximal value is present—since this will be the value targeted when \( v.\text{POS} \) is present regardless of the presence or absence of a maximal value in the scale associated with the degree achievement. In addition to these two cases, recall that, when -su is present, another possibility is available: when the scale does not include a lexical maximal value, a contextual maximal value is used.\(^{12}\) The three cases are stated in (42). I distinguish lexical maximal values and contextual maximal ones by means of the notation \( \max^l \) and \( \max^c \) respectively.

\[
\begin{align*}
\text{(42) a. } \quad & \text{If } m_\Delta \text{ has a (lexical) maximal value } \max, \ g(i) = \max^l(m_\Delta). \\
\text{b. } \quad & \text{If } m_\Delta \text{ does not have a (lexical) maximal value } \max, \ g(i) = \max^c(m_\Delta). \\
\text{c. } \quad & \ g(i) = \min(m_\Delta).
\end{align*}
\]

\(^{12}\)Note that this case is not completely out in English. It is needed when a telic reading of a degree achievement without a lexical maximal degree in the scale associated with it is targeted (see Hay et al. 1999 for discussion).
To illustrate the mechanics of the account, recall the examples in (29), to which I add -su:

(43) a. Mariya ŋik’ut(a)-∅ llusk’a-ch(a)-su-(i)-wa.
   Mariya hair-ACC straight-cha-su-3S-EVI
   ‘Mary straightened the hair.’

   Mariya mis(a)-∅ q’añu-ch(a)-su-(i)-wa.
   Mary table-ACC dirty-cha-su-3S-EVI
   ‘Mary dirtied the table.’

   c. Jaqi uka thak(i)-∅ thaki-ch(a)-su-(i)-wa.
   person that path-ACC path-cha-su-3S-EVI
   ‘The people built that path.’

With regard to the sentences when -su is absent (i.e., (29)), the reasoning is as follows: they all have v:POS. In this case, the standard function could equal a minimal or a maximal value, since v:POS shows no restriction whatsoever in this regard. However, the standard will not equal a maximal degree in these cases, because there is another lexical alternative, -su, which is used instead to denote that a maximal degree is reached. Thus, the standard with v:POS will equal a minimum. With regard to the sentences when -su is present, the value of the standard is specified in the denotation of -su. Specifically, there is a domain restriction that explicitly states that for the sentences to be defined the standard must equal a maximal degree. In (43a) and (43c), the standard equals a maximal degree that is lexical, since the scales associated with the verbal predicates incorporate lexical maximal degrees. In (43b), on the other hand, the standard equals a maximal degree that is contextual, as the scale associated with the verbal predicate does not incorporate a lexical maximal degree.

The denotations of (29) and (43) appear below. The denotations of the sentences in (29) (those without -su, i.e., with v:POS) appear in (44). Here it is made explicit that the standard equals a minimum, which falls under the assignment in (42c). These correspond with the comparative readings. The denotations in (45) are the ones of the sentences with -su in (43). Here the standard equals maximal degrees, whether lexical, as in (45a) and (45c) (this falls under the assignment in (42a)), or contextual, as in (45b) (this falls under the assignment in (42b)). These correspond with the absolute readings.

(44) a. \[\lambda e[\text{straight}_\Delta (\text{hair}, e) > \min (\text{straight}_\Delta)]\]

b. \[\lambda e[\text{dirty}_\Delta (\text{table}, e) > \min (\text{dirty}_\Delta)]\]

c. \[\lambda e[\text{path-build}_\Delta (\text{that path}, e) > \min (\text{path-build}_\Delta)]\]

(45) a. \[(43a)] \text{is defined iff } g(i) = \max (\text{straight}_\Delta).
   \text{When defined, } \[(43a)] = \lambda e[\text{straight}_\Delta (\text{hair}, e) = \max (\text{straight}_\Delta)]

b. \[(43b)] \text{is defined iff } g(i) = \max (\text{dirty}_\Delta).
   \text{When defined, } \[(43b)] = \lambda e[\text{dirty}_\Delta (\text{table}, e) = \max (\text{dirty}_\Delta)]

c. \[(43c)] \text{is defined iff } g(i) = \max (\text{path-build}_\Delta).
   \text{When defined, } \[(43c)] = \lambda e[\text{path-build}_\Delta (\text{that path}, e) = \max (\text{path-build}_\Delta)]

The proposal accounts for the telicity contrast discussed in section 3. Since -su targets maximal degrees only, telic adverbials are grammatical (i.e., the absolute readings targeted in the
presence of \(-su\) correspond with telic readings), but atelic ones are ungrammatical (when \(-su\) is present, the comparative reading is not possible). In the case of \(v\).POS, the opposite holds, since the standard equals a minimum in the scale: since the comparative reading is targeted, atelic adverbials are possible, whereas telic adverbials are not.

4.4. Predictions

The analysis predicts that it should only be possible to combine \(-su\) with verbs that allow degree morphology. This is borne out. Consider the examples below. The examples in (46) include a lexical degree achievement: the verb \(ch’iyara-\text{\textbar}n\) ‘to darken’ allows \(-su\). The example in (47) includes \(pichawaya-\text{\textbar}n\) ‘to sweep’ (an activity according to its aspectual class); here \(-su\) is not allowed.

(46) a. Jusiya uka is(i)-\(\emptyset\) ch’iyar(a)-i-wa.
Joseph this dress-ACC darken-3S-EVI
‘Joseph darkened the dress to a non-maximal degree.’

b. Jusiya uka is(i)-\(\emptyset\) ch’iyar(a)-\(-su\)-(i)-wa.
Joseph this dress darken-\(-su\)-3S-EVI
‘Joseph darkened the dress to a maximal degree.’

(47) a. Jusiya ut(a)-\(\emptyset\) pichaway(a)-i-wa.
Joseph house-ACC sweep-3S-EVI
‘Joseph sweeped the house.’

b. *Jusiya ut(a)-\(\emptyset\) pichaway(a)-\(-su\)-(i)-wa.
Joseph house-ACC sweep-\(-su\)-3S-EVI
‘Joseph sweeped the house to a maximal degree.’

Another interesting case to test involves the suffix \(-ra\), which also derives degree achievements in Aymara. The distribution of the bases this suffix takes shows that gradable bases including a lexical maximal degree are ungrammatical. It can only take gradable bases that do not include it, as illustrated below—I set aside further differences between verbs with \(-cha\) and \(-ra\):

(48) a. *q’amu-\(ra\)-\(\text{\textbar}n\) ‘to clean’

b. qañu-\(ra\)-\(\text{\textbar}n\) ‘to dirty’

(49) a. *llusk’a-\(ra\)-\(\text{\textbar}n\) ‘to straighten’

b. phirqa-\(ra\)-\(\text{\textbar}n\) ‘to curl’

More generally, degree achievements with \(-ra\) cannot denote maximal degrees. Of particular interest here is that \(-su\) is ungrammatical with degree achievements derived with \(-ra\), which is expected if \(-su\) targets maximal degrees.

(50) a. *qañu-\(r(a)-su\)-\(\text{\textbar}n\) ‘to dirty to a (contextual) maximal degree’

b. *phirqa-\(r(a)-su\)-\(\text{\textbar}n\) ‘to curl to a (contextual) maximal degree’
Finally, recall adverbial expressions. As discussed in subsection 2.1, verbs with -cha allow adverbial modification with elements like sinti ‘a lot’, sinti-puni ‘too much’ and juk’aki ‘a little’. These elements are also possible in verbs with -cha taking -su. The expectation is that the former should be possible and the latter should be marked with sentences uttered out of the blue, since the former is compatible with high degrees, including maximal ones, whereas the latter is compatible with low (non-maximal) degrees. This prediction is borne out, as shown in (51).

(51) Jaqi sinti / sinti-puni / ?*juk’aki uka ut(a)-0 uta-ch(a)-i-wa.
    person a.lot / too.much / a.little that house-ACC house-cha-3S-EVI
    ‘There was a lot/too much/a little of the people’s building of that house (to a maximal degree).’

5. Conclusion

This paper provides evidence for a two degree morpheme system combining with scalar predicates in Aymara. The suffix -cha derives degree achievements and creation predicates. I argued that they should be analyzed uniformly as degree achievements. I further discussed that telic readings correspond with the presence of the suffix -su; in its absence, atelic readings are yielded. I proposed that -su is a degree morpheme that is in competition with a verbal positive morpheme v.POS. The former restricts the standard of comparison to maximal degrees, whereas the latter remains unrestricted. For this reason, -su is preferred over v.POS whenever a maximal degree is reached. Aymara then differs from English in that in the former telicity contrasts rely on the presence or absence of lexical means (i.e., of -su), whereas in the latter there is a need to resource to a pragmatic principle to maximize the lexical means that are present in the base predicate included in the verb. The Aymara system thus enriches our typology regarding how telicity is achieved cross-linguistically when scalar verbs are considered.

References


13Only when it is made explicit via contextual cues that the maximal degree is very low in the scale does juk’aki ‘a little’ become better. This suggests that reaching a maximal degree does not necessarily mean to become a member of the positive extension of the gradable base—which is a possible case under the analysis pursued here under (42b), where a contextual maximal degree is assigned.


Abstract. Maximizers (completamente ‘completely’, totalmente ‘totally’) are degree modifiers restricted to maximum standard adjectives. Spanish adjectives of completeness [ACs] (completo ‘complete’, total ‘total’) display a behavior similar to that of their adverbial counterparts when they combine with nouns like idiot. This paper argues that ACs are maximality modifiers of idiot-like nouns, which are defended to be gradable and denote extreme degrees of properties. Establishing a parallelism between adverbs and adjectives of completeness allows us to explore scalarity across categories and the relevance of scale structure in the nominal domain.

Keywords: extreme nouns, maximizers, adjectives of completeness, scale structure, nominal gradability.

1. Introduction

Maximizers are degree modifiers that compose only with adjectives that use a scale with a maximum (Rotstein and Winter, 2004; Kennedy and McNally, 2005). Some of these modifiers have adjectival forms that combine with nouns. These adnominal forms are thus a valuable way of exploring gradability, and ultimately scale structure, in the nominal domain. In Spanish, the adnominal counterparts of the maximizers completamente ‘completely’ and totalmente ‘totally’ appear with nouns like idiot (1).

(1) Juan es un {completo idiota / total desastre}.
    ‘Juan is a complete idiot / total mess’

The type of modification completo ‘complete’ or total ‘total’ [henceforth, adjectives of completeness or ACs] perform in the noun seems to be degree modification. If it is so, two issues arise. First, nouns like idiot would be gradable. Second, ACs would be degree modifiers sensitive to scale structure. This is in conflict with the common view of nouns as non-gradable, as opposed to adjectives (see Bolinger, 1972; Matushansky, 2002; Morzycki, 2009; Constantinescu, 2011; Sassoon, 2013, a.o.).

This paper argues that ACs are maximality modifiers of idiot-like nouns, which are gradable and denote extreme degrees. I adopt Morzycki’s (2012a) analysis of extreme adjectives for

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Spanish evaluative nouns. Nouns like *idiot* include a degree argument and a requirement that the value of this argument is above the contextually relevant scale. The degrees that are off the scale constitute a maximum for ACs, and also explain the partial maximizer behavior of these modifiers with *idiot*-like nouns. This analysis thus unifies the semantics of adverbs and adjectives of completeness and discusses the relevance of scale structure in the nominal domain.

This paper proceeds as follows. §2 introduces the data about maximizers in the adjectival domain, which is compared to the behavior of ACs when modifying *idiot*-like nouns in §3. §4 is devoted to show that nouns like *idiot* are gradable and denote extreme degrees and puts forward an analysis of these nouns as extreme predicates. It also discusses their subjectivity. The semantics of ACs is tackled in §5, which includes a discussion of previous analyses in terms of quantification over properties. Finally, §6 concludes.

2. Maximizers in the adjectival domain

The scales used by gradable adjectives differ in whether they include a maximal and/or a minimum value (Rotstein and Winter, 2004; Kennedy and McNally, 2005). These endpoints are relevant for the calculation of the standard for the predicate. Particularly, the standard of comparison of the adjective is set to the value of the upper or lower bound of the scale whenever there is one. Otherwise, the standard is computed contextually (Kennedy, 2007). From this observation, a typology of adjectives based on their scale structure can be established (2) (Rotstein and Winter, 2004; Kennedy and McNally, 2005).

\begin{enumerate}
\item (Totally) open scale adjectives: *alto* ‘tall’, *ancho* ‘wide’, *bello* ‘beautiful’
\item Lower closed scale adjectives: *sucio* ‘dirty’, *impuro* ‘impure’, *húmedo* ‘wet’
\item Upper closed scale adjectives: *limpio* ‘clean’, *seco* ‘dry’, *libre* ‘free’
\item (Totally) closed scale adjectives: *abierto* ‘open’, *lleno* ‘full’, *oscuco* ‘dark’
\end{enumerate}

Some modifiers are sensitive to the scale structure of the adjectives. For instance, maximizers such as *completamente* ‘completely’ or *totalmente* ‘totally’ only appear with upper or totally closed scale adjectives (3) (Rotstein and Winter, 2004; Kennedy and McNally, 2005).

\begin{enumerate}
\item completamenti { *seco* / *oscuco* / *libre* / *abierto* / *limpio* / *lleno* } \\
\hspace{1cm} completely dry dark free open clean full
\item ?completamente { *alta* / *ancho* / *bello* / *impuro* / *sucio* } \\
\hspace{1cm} completely tall wide beautiful impure dirty
\end{enumerate}

Maximizers convey that the referent has a maximal degree of the gradable property denoted by the adjective they modify. Formally, these modifiers set the value of the degree argument of the adjective $G$ to the maximum in its scale $S_{G}$ (4) (Kennedy and McNally, 2005). The restriction on upper and totally closed scale adjectives is accounted for by the function *max*, which only yields a value if the scale has a defined maximum.
Maximizers share a number of properties. First, they entail that the end of the scale has been reached. Consequently, it is contradictory to assert that the referent can have a higher degree of the property (5a) (Kennedy and McNally, 2005). Second, the construction maximizer $G$ is a total construct, in the sense that it has the distribution of an upper-closed scale adjective (Rotstein and Winter, 2004). This is shown by the fact that it is compatible with casi ‘almost’ (5b). And third, because of the universal quantification in the semantics of the max function, maximizer $G$ accepts exceptive phrases (5c).

(5) a. #El avión está completamente lleno; hay un asiento libre en la primera fila.
   The plane is completely full; there is a seat free in the first row
   'The plane is completely full; there is an empty seat in the first row.'
   b. El avión está casi completamente lleno.
   the plane is almost completely full
   c. El avión está completamente lleno, excepto un asiento en la primera fila.
   the plane is completely full except a seat in the first row
   'The plane is completely full, except for a seat in the first row.'

In short, maximizers are degree modifiers restricted to adjectives that lexicalize a scale closed (at least) in its upper end. They set the degree of the property denoted by the adjective to its maximum value. Next section is devoted to show the behavior of ACs with idiot-like nouns.

3. Adjectives of completeness and idiot-like nouns

As shown in (1), nouns like idiot combine with ACs. The question is whether these modifiers are acting like maximizers when appearing with nouns like idiot. This section compares the properties of ACs modifying these nouns to those of maximizers modifying adjectives.

First, maximizers entail that the end of the scale associated with the predicate has been reached (5a). Consequently, the referent cannot have more of the property denoted by the predicate than it already has. As expected, there is a contradiction in asserting that Juan could be more of an idiot than a complete idiot (6a). However, when Juan’s complete idiocy is compared to someone else’s, the examples become more acceptable, although not perfect (7a).

(6) a. #Juan es un completo idiota, pero podría serlo más.
   Juan is a complete idiot but could be more
   'Juan is a complete idiot, but he could be more of an idiot.'
   b. #La clase es un absoluto desastre, pero podría serlo más.
   the class is a absolute mess but could be more
   'The class is an absolute mess, but it could be more of a mess.'
Second, although maximality modifiers are compatible with casi ‘almost’ (5b), they are ruled out with nouns like idiot (8a). And third, expressions including maximizers accept exceptive phrases (5c). As for idiot-like nouns, exceptions are acceptable, yet slightly degraded (7a).

(7) a. ¿Juan es un completo idiota, pero su hermano lo es más.
   Juan is a complete idiot but his brother CL is more
   ‘Juan is a complete idiot, but his brother is more of an idiot.’

b. ¿La clase es un absoluto desastre, pero la de María lo es más.
   the class is a absolute mess but the of María CL is more
   ‘The class is an absolute mess, but María’s is more of a mess.’

(8) a. ¿Juan es un casi completo idiota.
   Juan is a almost complete idiot
   ‘Juan is an almost complete idiot.

b. La clase es un casi absoluto desastre.
   the class is a almost absolute mess
   ‘The class is an almost absolute mess.

(9) a. Juan es un completo idiota, menos en su trabajo.
   Juan is a complete idiot except in his work
   ‘Juan is a complete idiot, except at work.’

b. La clase es un absoluto desastre, excepto el día del examen.
   the class is a absolute mess except the day of the exam
   ‘The class is an absolute mess, except for the day of the exam.’

The data shows that the modification of an idiot-like noun by an AC resembles modification by maximizers, but only partially. The issue is whether an analysis of ACs as maximizers can be maintained. In this paper I defend that it can. In order to show how the data in this section would be explained, the semantics of nouns like idiot is discussed next.

4. Extreme nouns

Evaluative nouns like idiot constitute a class of nouns that do not only assign a property to an individual, but also express a value judgment. Several contexts set them apart from non-evaluative nouns. First, nouns like idiot appear in the first position in qualitative nominal constructions such as the so-called N of an N construction (10) (Bolinger, 1972; Doetjes and Rooryck, 2003; den Dikken, 2006; Villalba and Bartra-Kaufmann, 2010, a.o.). Non-evaluative nouns such as doctor only receive a possessive reading (e.g., ‘Juan’s doctor’).

The class of evaluative nouns has been referred to as degree nouns (Bolinger, 1972) or scalar nouns (Matushansky, 2002), and quality nouns (Milner, 1978; Ruwet, 1982). The class includes other nouns (nouns like ‘matasanos’ quack or ethnic slurs) that I set aside from the discussion (see Masià, forthcoming). For this reason, I mostly refer to the nouns under discussion as ‘idiot’-like nouns, and extreme nouns once the analysis is presented.
In addition, in Spanish idiot-like nouns appear in attributive construction with the indefinite articles (11a), in the so-called ‘un’ enfático (‘emphatic un’) construction (Portolés, 1994; Fernández Leborans, 1999, a.o.). This contrasts with the behavior of nouns expressing a specific role in society, which appear bare (11b) (Déprez, 2005; de Swart et al., 2007, and references therein).

(11) a. Juan es *(un) {genio / desastre}.
   Juan is a genius mess
   ‘Juan is a {genius / mess}.’
b. Juan es (*un) {médico / secretario}.
   Juan is a doctor secretary
   ‘Juan is a {doctor / secretary}.’

Finally, these nouns can be used in verbless exclamatives (12a) (Vinet, 1991; Hernanz, 2001, a.o.) and independent ones (12b) (Milner, 1978; Suñer Gratacós, 1999; Hernanz, 2001, a.o.).

(12) a. ¡Un {idiota / genio / desastre / *médico}, este tío!
    a idiot genius mess doctor this guy
    ‘A(n) {idiot / genius / mess / doctor}, this guy!’
b. ¡{Idiota / Genio / Desastre / *Médico}!
    idiot genius mess doctor
    ‘{Idiot / Genius / Mess / Doctor}’!

These tests set apart the class of evaluative nouns, of which idiot-like nouns are a subset (for more diagnostics, see Milner, 1978; Ruwet, 1982; Suñer Gratacós, 1999, a.o.). Part of the literature considers that evaluative nouns contain some sort of affective feature that allows them to appear in the above constructions (Milner, 1978; Hernanz, 2001, a.o.; cf. Ruwet, 1982; den Dikken, 2006). Others have argued that the relevant characteristic is a degree argument (Bolinger, 1972; Matushansky, 2002; for discussion, see Constantinescu, 2011).

In this section, I argue that nouns like idiot denote extreme degrees of properties. In order to do so, I first give arguments in favor of a degree analysis of these nouns. Then I compare their properties to those of extreme adjectives. Afterwards, the analysis of idiot-like nouns is provided. Finally, the subjectivity of these nouns is addressed.

4.1. Idiot-like nouns are gradable

As just mentioned, some authors take the properties and distribution of evaluative nouns to be linked to the presence of a degree argument (e.g. Bolinger, 1972; Matushansky, 2002).
Certainly, if some nouns are more likely candidates than others to denote gradable properties, those are evaluative nouns, *idiot* being the quintessential example (Bolinger, 1972; Morzycki, 2009, 2012b, 2014; de Vries, 2010; cf. Constantinescu, 2011, 2013; Sassoon, 2013). This section provides arguments in favor of nouns like *idiot* containing a degree argument.

Because of their monotonicity, gradable predicates obtain degree readings when modified by downward-entailing modifiers such as *surprisingly* or *unbelievable* (de Vries, 2010, forthcoming, Nouwen, 2011). Nouns like *idiot* are interpreted in a degree sense when modified by the adnominal versions of those modifiers (13), unlike nouns like *doctor*. For instance, *un idiota increíble* ‘an incredible idiot’ is an idiot to a high degree.

(13)  Juan es un {idiota / ¿genio / desastre / #médico} increíble.
    Juan is a idiot genius mess doctor incredible
    ‘Juan is an incredible {idiot / genius / mess / doctor}.’

Degree readings are also obtained with size adjectives (Morzycki, 2009; de Vries, 2010; Sassoon, 2013). When a noun like *idiot* combines with an adjective like *enorme* ‘huge’, the interpretation is that the referent has a high degree of the property. Compare this to *médico enorme* ‘huge doctor’, where only physical size is available as an interpretation (14).

(14)  Juan es un {idiota / genio / desastre / #médico} enorme.
    Juan is a idiot genius mess doctor huge
    ‘Juan is a huge {idiot / genius / mess / doctor}.’

The modification in the examples above is subject to the two properties that characterize degree uses of size adjectives (see Morzycki, 2009). First, the bigness generalization asserts that only adjectives of bigness get degree readings, adjectives of smallness do not. This is true of size adjectives modifying *idiot*-like nouns. The examples in (15a), although odd, only get a physical size interpretation. Second, the position generalization states that degree readings of size adjectives are only possible in attributive position. That is again the case with *idiot*-like nouns. Examples (15b) only present a physical size reading.

(15)  a.  Juan es un {#pequeño / ¿?diminuto / ¿?minúsculo} idiota.
    Juan is a small tiny minuscule idiot
    ‘Juan is a {small / tiny / minuscule} idiot.’
    b.  #Este idiota es {grande / enorme / gigantesco}.
    this idiot is big huge gigantic

Interrogatives provide further evidence for the gradability of *idiot*-like nouns. In particular, just like gradable adjectives (16a), these nouns appear in degree interrogatives with *cómo de* in Spanish (16b). Regular nouns like *doctor* are excluded from this construction. The same happens with quantity exclamatives with *cuán* ‘how’ (17).
So far, it seems that nouns like idiot are gradable. At this point, it is reasonable to question what type of scale structure they use (see §2). The data in §3 already showed that ACs do not have a clear-cut behavior as maximizers when modifying idiot-like nouns, not completely supporting the idea that they use upper-closed scales.

Focusing on data from entailments of the comparative construction (Kennedy and McNally, 2005), nouns like idiot pattern with minimum-standard adjectives in triggering entailments to the unmarked form (18) (Constantinescu, 2011, de Vries, forthcoming). In other words, if someone is more of an idiot than someone else, it is entailed that the first person is an idiot.3

To sum up, idiot-like nouns are gradable and seem to have minimum standards. That is, having only a small degree of the relevant property (idiocy, messiness, etc.) is enough to qualify as an idiot, a mess, etc.4 In the next section I argue that idiot-like nouns denote extreme degrees.

4.2. Idiot-like nouns denote extreme degrees

Adjectives such as wonderful or horrible refer to a very high or the highest degree of a property (Cruse, 1986) and, in this sense, are close to superlatives. This class of adjectives that includes extremeness in their lexical semantics are often referred to as extreme adjectives (Cruse, 1986; Paradis, 1997, 2001; Morzycki, 2012a). In this section, I argue that nouns like idiot also denote extreme degrees of properties (see also Constantinescu, 2011; Morzycki, 2012a, 2014).

3Although nouns like idiot in comparative constructions in Spanish are somewhat degraded (especially if the determiner appears), speakers find that the entailments still come through.

4De Vries argues that this is related to the fact that these nouns do not have a prototype that may constitute an upper bound (for details, see de Vries, 2010, forthcoming).
Intuitively, for someone to qualify as an idiot, just some degree of dumbness is not enough, the individual needs to be remarkably dumb.

To begin with, some of the contexts in §4 allow adjectives in the relevant positions. However, being gradable is not enough for adjectives to appear in these constructions. Rather, they need to denote extreme degrees. For example, non-extreme adjectives such as tall are excluded in the $N$ of a $N$ construction (19a) (cf. (10)) (Constantinescu, 2011). The same is true of verbless or independent exclamatives (19b) (cf. (12a)) (Vinet, 1991; Hernanz, 2001, a.o.).

(19) a. el {??alto / ??amable / horrible / magnífico} de Juan
   the tall nice horrible great of Juan
   'that {tall / nice / horrible / great} Juan.'
b. ¡{??Alto / ??Amable / Horrible / Magnífico}(, este chico)!
   tall nice horrible great this guy
   ' {Tall / Nice / Horrible / Great}(, this guy)'

In addition, extreme predicates display several specific properties. First, they have their own specialized degree modifiers. While modifiers such as directamente ‘downright’ do not appear with non-extreme adjectives, regular degree modifiers like bastante ‘fairly’ do not occur with extreme adjectives (20) (Cruse, 1986; Paradis, 1997; Hernanz, 2001; Morzycki, 2012a, a.o.). In the same way, nouns like idiot combine with equivalent adnominal modifiers, which are impossible in their degree reading with non-gradable nouns such as doctor (21).

(20) a. Juan es directamente {maravilloso / ??alto}.
    Juan is downright wonderful tall
b. Juan es bastante {??maravilloso / alto}.
    Juan is fairly wonderful tall

(21) a. Juan es un valiente {idiota / genio / #médico}.
    Juan is a brave idiot genius doctor
    ‘Juan is a downright {idiot / ??doctor}.’
b. La clase es una soberana {maravilla / *actividad}.
    the class is a supreme wonder activity
    ‘The class is a full-on {wonder / *activity}.’

Second, extreme predicates are somewhat unnatural in comparatives, with different degrees of acceptability among speakers, but more acceptable in equatives (22) (Cruse, 1986; Paradis, 1997; Morzycki, 2012a). Idiot-like nouns are also slightly more degraded in comparative than in equative structures (23).

(22) a. Juan es más {??maravilloso / ??horrible / alto} que Sofía.
    Juan is more wonderful horrible tall than Sofía
b. Juan es tan {maravilloso / horrible / alto} como Sofía.
   Juan is as wonderful horrible tall as Sofía

(23) a. ??Juan es más (un) genio que Sofía.
   'Juan is more a genius than Sofía.'
b. ?Juan es tan genio como Sofía.
   'Juan is as much of a genius as Sofía.'

Third, extreme predicates can be intensified through prosodic prominence (24a) (Cruse, 1986; Bolinger, 1972; Morzycki, 2012a). Idiot-like nouns behave accordingly (24b).

(24) a. Kevin Spacey is {fantaaastic / ??gooooooood}!
   (Morzycki, 2012a)
b. Juan es un {idioooota / ??méeeedico}.
   Juan is a idiot doctor

In short, nouns like idiot denote extreme degrees of properties. The tests in this section showed that they behave like extreme adjectives. It can be thus concluded that these nouns encode extremeness in their lexical semantics. This idea is implemented in the next section.

4.2.1. Analysis

In order to account for the semantics of nouns like idiot, I adopt Morzycki’s (2012a) analysis of extreme adjectives. The basic intuition is that different subsets of scales are relevant in different contexts, and extremeness consists of going off the relevant scale, to a point where no further distinctions between degrees are made (Morzycki, 2012a). For instance, in order to qualify as an idiot, someone has to be dumb to a degree above any expectation, off the relevant scale for the adjective dumb, in a zone of indifference between degrees of dumbness.

This idea connects with contextual domain restriction. In the same way quantifiers are contextually restricted (e.g. von Fintel, 1994), degree quantification is also subject to contextual variation in its domains (e.g. Zanuttini and Portner, 2003). Contextual domain restriction is thus introduced in the denotation of ordinary adjectives (Morzycki, 2012a). The semantics for dumb in (25a) includes the restriction that the degree d has to be in the salient set of degrees in the contextual scale C. In the absence of degree morphology, the null morpheme POS saturates the degree argument and establishes the requirement that the degree exceeds the standard (25b).

(25) a. \[dumb = \lambda d \lambda x[d \in C \land dumb(d)(x)]\]
    b. \[\text{POS } dumb_C = \lambda x. \exists d [d \in C \land dumb(d)(x) \land d \succeq \text{stnd}([dumb_C])]\]
   (Morzycki, 2012a)
Extreme predicates exceed the contextually-provided set of degrees. This is reflected in the condition that their degree $d$ of the property is greater than the maximal degree in the contextual scale $C$ (Morzycki, 2012a). Extending the analysis to nouns like *idiot*, their denotation would be as in (26).

(26)  
\[ [\text{idiot}_C] = \lambda d \lambda x [d > \max(C) \land \text{dumb}(d)(x)] \]
\[ [\text{genio}_C] = \lambda x \lambda d [d > \max(C) \land \text{smart}(d)(x)] \]

Under this analysis, like gradable adjectives in a degree-based framework, nouns like *idiot* have degree arguments and are lexically associated with scales. Just like in the case of adjectives, a degree morpheme is necessary to get to a property of individuals. If no overt degree word is present, I assume a null POS morpheme saturates the degree argument (Morzycki, 2009). According to (27), an individual is an idiot if, and only if, she is dumb to a degree $d$ that exceeds the standard for the predicate in $C$ and that is greater than the highest salient degree of dumbness in $C$. In this case, the standard and the domain restriction interact: for the standard to be relevant, it must be beyond the perspective scale.

(27)  
\[ [\text{POS idiotac}] = \lambda x . \exists d [d > \max(C) \land \text{dumb}(d)(x) \land d \geq \text{std}(\text{idiotac})] \]
\[ [\text{POS geniusc}] = \lambda x . \exists d [d > \max(C) \land \text{smart}(d)(x) \land d \geq \text{std}(\text{geniusc})] \]

Nouns like *idiot* are fundamentally adjective-like, as manifested in their similar distribution in inversion constructions (10), (19a), exclamatives (12), (19b), and questions (16). The denotations in (27) reflect this adjectival condition of these nouns not only by providing them with gradable semantics, but also by using adjectival measure functions. Besides this, by including the measure function of the non-extreme or more neutral adjective, the denotation of extreme nouns accounts for the entailments to the non-extreme form (28). Any individual dumb enough to be an idiot must have a degree of dumbness beyond $C$; by monotonicity, any individual dumb to that degree is dumb to all the degrees below, including the standard for *dumb*.

(28)  
\( a. \) Juan es un idiota. $\rightarrow$ Juan es tonto.
   Juan is a idiot Juan is dumb
\( b. \) Juan es un genio. $\rightarrow$ Juan es listo.
   Juan is a genius Juan is smart

Hernanz (2001) argues that evaluative expressions have a *wh*-feature that explains their occurrence in inversion constructions, exclamatives, and other *wh*-like behavior. In the analysis of nouns like *idiot* put forward here, they include a widening in the domain of degrees. In particular, these nouns refer to degrees that exceed the maximal degree in the salient set of degrees. This connects with Zanuttini and Portner’s (2003) analysis of *wh*-exclamatives, according to which exclamatives involve domain widening by the combination of a *wh*-word and a factive

\footnote{Looking ahead, ACs are argued to be overt degree morphemes in the next section. Morzycki (2009) actually already considers ACs to be adnominal degree morphemes, but his analysis differs from ours in that his gradable nouns do not denote extreme degrees.}
operator. Thus, there seems to be a connection between wh-behavior and evaluativity that could be made explicit by our analysis.

One way of doing this could be to link extremeness to mirativity (DeLancey, 1997; for analyses of exclamatives as mirative constructions, see Michaelis, 2001; Castroviejo Miró, 2006), and, ultimately, to expressivity (see Martin, 2007 for extreme adjectives). More specifically, the fact that the individual has a property to an unexpectedly high degree is accompanied by an emotion (surprise, but also other emotions like annoyance) by part of the speaker. This emotional attitude arises from the truth-conditional meaning of evaluative nouns and constitutes their expressive meaning.6 For instance, if someone is smart to so extreme a degree to qualify as a genius, it causes in the speaker an emotional attitude of surprise or admiration towards that individual.

To summarize, nouns like idiot have been given a denotation that involves extreme degrees, following the analysis for extreme adjectives in Morzycki (2012a). In particular, they are gradable properties of individuals, with the requirement that the degree of the property exceed the contextually salient set of degrees. Next section discusses subjectivity of extreme nouns.

4.3. Consequences of the analysis: subjectivity

Before proceeding to the analysis of ACs, let me briefly discuss one consequence of the analysis above, which helps clarify the connection between being extreme and being evaluative. Subjective predicates are predicates whose truth is relativized to the perspective of a judge (Lasersohn, 2005; Stephenson, 2007; Bylinina, 2014, a.o.). For instance, a sentence like Roller-coasters are fun may be true for one speaker but false for another, and both can be right at the same time.

Extreme nouns pass the tests for subjectivity. They can appear as the complement of subjective attitude verbs (29a) Sæbø, 2009 and they give rise to faultless disagreement (29b) (Lasersohn, 2005; Stephenson, 2007). Regarding the latter, speaker B’s does not constitute a contradiction, because both speakers can be right.

(29) a. Juan me parece {divertido / un idiota / un genio / un desastre}.
   Juan DAT.1SG find funny a idiot a genius a mess
   ‘I find Juan {funny / an idiot / a genius / a mess}.’

   b. A: Juan es {divertido / un idiota /un genio / un desastre}.
   ‘Juan is {funny / an idiot / a genius / a mess}.’
   B: No, no lo es.
   ‘No, he’s not.’

Adjectives can be subjective in two ways (Bylinina, 2014; Kennedy, 2016). They can be subjective with respect to the threshold for its application or with respect to the ordering of the

6In this paper, I leave the expressive component of idiot-like nouns aside, but see Masià (2017b) for an analysis.
individuals in their extension. For instance, fun is subjective regarding its standard: two speakers may disagree on whether roller-coasters are above the standard for fun because one places the standard higher than the other. In addition, the ordering of the set {roller-coasters, climbing, reading} for fun may be ⟨roller-coasters, climbing, reading⟩ for one speaker, but ⟨reading, roller-coasters, climbing⟩ for another. Since idiot-like nouns have been argued to use adjectival scales from evaluative adjectives in their semantics (26) and these adjectives are subjective in the two ways (Bylinina, 2014; Kennedy, 2016), extreme nouns are expected to be two-way subjective as well.

The tests in (29), using the positive form of the adjective and a positive construction for the noun, show that extreme nouns are subjective with respect to their standard. Subjectivity with respect to their ordering is detected by the acceptability of the comparative form in the diagnostics above. Since extreme nouns in the comparative form are slightly degraded, so are the examples in (30) including them. Nevertheless, they are not ruled out with subjective attitude verbs (30a) and they give rise to faultless disagreement (30b).

(30)  
   a. Juan me parece más {divertido / ?genio / ?desastre} que Sofía.
       ‘I find Juan {funnier / more of a genius / more of a mess} than Sofía.’
   b. A: Juan es más {divertido / ?genio / ?desastre} que Sofía.
       ‘Juan is {funnier / more of a genius / more of a mess} than Sofía.’
      B: No, no lo es. ‘No, he’s not.’

Just like evaluative adjectives, extreme nouns seem to be subjective in two ways. I suggest that this fact can be related to the presence of adjectival measure functions in the lexical semantics of nouns like idiot in the analysis put forward in §4.2.1. Next section presents the analysis of ACs as adnominal maximizers.

5. Back to adjectives of completeness

5.1. Adjectives of completeness are maximizers

Since idiot-like nouns denote gradable properties, an analysis of ACs as degree modifiers is sustained. However, there are some difficulties. Maximizers are sensitive to scale maximums, but the nouns under discussion seem to use scales with no upper-bound (§4.1). Therefore, either the maximum for ACs must be provided by something other than a bound in a lexical scale, or, alternatively, ACs need to be analyzed as non-maximizers. In this section I argue for the first option, showing that the special behavior of ACs with nouns like idiot can be derived from the particularities of the extremeness the latter include in their lexical meaning.

Paradis (1997) observes that extreme adjectives have an inherent superlativity, and, in this sense, they represent the ultimate point of a scale. She argues that maximizers combine with adjectives such as wonderful to reinforce their extremeness. In the approach to extremeness
adopted in the previous section (Morzycki, 2012a), the contextually provided scale contributes a sort of maximum: the degrees above it. Since these degrees are undifferentiated, they can be thought of as a single one. For instance, for a noun like idiot, it is not the case that there is a ceiling of idiocy, but rather, above certain degree, we do not introduce any distinction between the degrees of idiocy of the individuals. In a sense, that set of indistinct degrees acts as a maximum (see Morzycki, 2012a: 606).

If the degrees above the salient scale form a kind of boundary, this may constitute an appropriate maximum for maximizers. I argue that it is in fact a degree that can be returned by the \texttt{max} function in the semantics of maximality modifiers. ACs can thus be analyzed as maximizers (31) (see also Morzycki, 2009).

(31) \[\lambda d.\forall x . d = \text{max}(S_G) \land G(d)(x)\]

The composition of an AC with an extreme noun is then as in (32a). The AC saturates the degree argument of the noun and sets its value to the maximum of the scale. Two restrictions apply on the degree \(d\). It must be above the relevant set of degrees in \(C\) and it must be the maximum (of the degrees off the scale lexicalized by \textit{dumb}).\footnote{This analysis of ACs is different from considering them extreme degree modifiers in Morzycki’s (2012a)’s terms. Under his analysis, modifiers such as \textit{downright} widen the domain of degrees to accommodate a new standard for the predicate. Roughly, the standard for \textit{downright gigantic} is situated above the already expanded domain for \textit{big} in the semantics of \textit{gigantic}. In my analysis, ACs target the widened set of degrees used by extreme nouns, but do not have a widening effect themselves. This analysis is compatible with other degree uses of ACs (see §2; see also Masià, 2017a, 2018).} According to this semantics, Juan is a complete idiot if, and only if, he has a degree of dumbness above the salient set of degrees in the context (32b).

(32) a. \([\text{completo}][\text{idiota}_C] = \lambda x.\exists d \ (d = \text{max}(S_{\text{idiota}_C}) \land \text{idiota}_C(d)(x)) = \lambda x.\exists d \ (d = \text{max}(S_{\text{idiota}_C}) \land d > \text{max}(C) \land \text{dumb}(d)(x))

b. \([\text{Juan es un completo idiota}] = \exists d \ (d = \text{max}(S_{\text{idiota}_C}) \land d > \text{max}(C) \land \text{dumb}(d)(\text{Juan}))\]

The fact that no distinction is made among the degrees above the relevant set of degrees in \(C\) has the consequence of blurring the difference between the unmodified and the modified extreme noun. Put differently, there is not a sharp distinction between being an idiot and being a complete idiot. This does not mean that ACs have no effect. By means of the maximality function, the degree of idiocy of complete idiot is always higher than that of idiot. But due to the fact that these degrees do not have exact, determinate values, the contrast is fuzzy. This may explain the oddness of the sentences in (33).

(33) a. ??Juan es un idiota, pero no un completo idiota.
Juan is an idiot but \texttt{NEG} a complete idiot

Juan is an idiot, but not a complete idiot.'
b. ??La clase es un desastre, pero no un absoluto desastre.
the class is a mess but NEG a absolute mess
‘the class is a mess, but not an absolute mess.’

5.2. Explaining the data

We can now explain the nonmaximizer behavior of ACs described in §3. Regarding the entailment that the end of the scale has been reached, recall that sentences with ACs and extreme nouns result in a contradiction when the degree of the property of the same individual is being compared (6a), but not when the comparison is drawn between the degrees of two different individuals (7a). For instance, saying that Juan is a complete idiot, but he could be more of an idiot is as contradictory as saying that a plane is completely full, but could be fuller (5a). By contrast, there is not so strong a conflict when asserting that Juan is a complete idiot, but someone else exceeds his degree of idiocy.

If Juan is a complete idiot, he has a maximal amount of idiocy, although the particular corresponding degree cannot be pinpointed, due to the fact that that degree is beyond the salient scale. It feels unnatural to recalculate that maximum when considering the same individual (unless some new facts are learned about Juan) because the speaker is contradicting her own property assignment. However, given that the maximum is undetermined, the speaker can situate it at a higher value than she originally did if the context changes (for instance, she meets Juan’s brother). In fact, note that the sentences improve if todavía ‘even’ is added (34).

(34) Juan es un completo idiota, pero su hermano lo es todavía más.
Juan is a complete idiot but his brother CL is even more
‘Juan is a complete idiot, but his brother is even more of an idiot than him.’

As for the incompatibility with casi ‘almost’ (8a), I suggest that it has to do with this expression presupposing an identifiable maximum. Almost targets a value that is close to the maximum, but has not reached it. If the maximum for, say, being an idiot cannot be singled out, the expression un casi completo idiota ‘an almost complete idiot’ would not return a concrete value either, and the difference between being a complete idiot and being an almost complete idiot would be trivial (see also Paradis, 1997: §3.3.3).

Exceptional phrases were fairly acceptable with ACs and extreme nouns (9a), as expected from a total construct. The presence of an AC usually has the side effect of decreasing the amount of imprecision allowed in the context. As a consequence, the number of exceptions is reduced, making exceptives slightly less felicitous than in the sentences without the maximizer.

Coming back to the scale structure of extreme nouns, the data in (18) pointed to them having a minimum standard. Although that still holds, their combination with ACs and the maximality interpretation that the latter receive provides evidence for them having a maximum as well. As
mentioned above, this is not a conventional maximum, but one made of degrees off the relevant contextual scale.

In short, ACs are maximizers of extreme nouns. They set the degree of the property denoted by these nouns to its maximum value. However, since those degrees exceed the contextually provided scale and no distinctions are made among them, the combination of ACs and extreme nouns presents a mixed behavior with respect to maximality. In the next section, I discuss a couple of alternative analyses.

5.3. Alternative analyses

Previous analyses of ACs take them to universally quantify over dimensions associated with the noun. This section reviews a non-degree and a degree proposal along these lines and shows that they are not sufficient to capture the distribution of ACs with extreme nouns.

Constantinescu (2011) argues that ACs in their intensifying use with idiot-like nouns signal the extent to which the property denoted by the noun holds of the object in question. She puts forward that ACs apply to the characteristic function included in the meaning of the noun (e.g. Bouchard, 2002; Demonte, 2008) and assert that the properties displayed by the individual match those associated with the noun, in the speaker’s opinion. However, the noun’s defining criteria does not have to be exhaustively satisfied, as shown by the nonmaximal behavior of ACs in these uses (see §3), it is enough if the relevant properties are clearly manifested in a salient way. For instance, for a workshop to be a complete failure, it may be enough if it is a failure in an aspect especially relevant to the speaker (e.g., quality of the talks), even if it is not in other less salient respects (e.g., quality of the coffee).

The idea that ACs indicate that the referent fully matches the definition of the noun is problematic. All nouns have a set of criteria an individual must satisfy to qualify as them. However, this reading of ACs is only available for extreme nouns. If the role of ACs were to assert that the noun is right for the individual, they would be expected to have this function with all nouns. For instance, the examples in (35) would be predicted to convey that those particular instances deserved to be referred to as a novel and a conference, respectively, but that is not the case.

(35) ?Esta es una completa {novela / conferencia}.
    this is a complete novel workshop
    ‘This is a comprehensive {novel / workshop}.’

The intuition that ACs indicate that the referent is an N in all the relevant dimensions associated with the noun can be recast in a degree-based framework. Sassoon (2013, 2017) argues that nouns like idiot are similar to adjectives in their occurrence with with respect to phrases (36).

(36) Dan is an idiot {with respect to money / in every respect}. (Sassoon, 2013)
Relatedly, de Vries (2010, forthcoming) claims that idiot-like nouns are gradable and use open scales (see also Morzycki, 2009). ACs are analyzed as modifiers that assert that the individual has every dimension associated with the noun. For instance, a total nerd would be someone who is nerdy with respect to his looks, social skills, intelligence, hobbies, etc. This predicts that nouns modified by ACs do not accept with respect to-phrases, but this is not borne out (37). Someone can be a total idiot or a complete mess only with respect to one dimension.

\[(37)\]  
\[\begin{align*}  
\text{a. } & \text{ Era un idiota total en cuanto a calorías, alimentos y cosas de esas.}^8 \\
& \quad \text{was a } \text{idiot total with regard to } \text{calories, food and things of those} \\
& \quad \text{‘I was a total idiot regarding calories, food, and things like that.’} \\
\text{b. } & \text{ Soy un completo desastre con respecto a las lanas y los proyectos.}^9 \\
& \quad \text{am a } \text{complete mess with respect to the yarns and the projects} \\
& \quad \text{‘I’m a complete mess with respect to yarn and (DIY) projects.’} 
\end{align*}\]

This said, it is not completely clear to me that all the with respect to phrases in (36), (37) target actual dimensions of the noun. What properties make someone an idiot? Someone may consider that not knowing how to manage money makes you an idiot, but that is certainly neither a necessary nor a sufficient condition to qualify as one. Rather, it seems one of the many ways in which someone can be an idiot. Consider a noun like smoker instead, which has clear(er) dimensions (Morzycki, 2012b). A smoker is someone who smokes a certain amount of cigarettes with a specific frequency. Some degree in both dimensions is necessary for someone to qualify as a smoker. A complete smoker would be someone who has a high degree in both dimensions. However, ACs are not felicitous with this noun (38).

\[(38)\]  
\[\text{??Juan es un completo fumador.} \\
\quad \text{Juan is a complete smoker}\]

Morzycki (2012b) argues that nouns like idiot are only associated with one dimension (e.g., idiocy). ACs are analyzed as modifiers that assert that the measurement of the individual along the dimension associated with the noun is large (39). For instance, Clyde is an utter idiot if, and only if, his measure along the unique dimension associated with idiot, idiocy, is large. ACs include the requirement that the noun have only one dimension (represented by the iota operator), accounting thus for their distribution.

\[(39)\]  
\[\uparrow \text{utter} f(c,t) \lambda x. \text{large}_c (\mu (\iota D[D \in \text{dimensions}(f)])(x))\]

The analysis put forward here resembles Morzycki’s (2012b) in that it assumes that the only dimension of measurement relevant for extreme nouns is the one provided by the measure function of their related adjectives. However, we have considered nouns like idiot to be gradable (extreme, in particular) (cf. Morzycki, 2009), and have argued that ACs can be analyzed as maximality modifiers, unifying them to the analysis of their adverbial counterparts.

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9http://www.waselwasel.com/crisis-tejeril/
In short, an analysis of ACs as quantifying over the characteristics or dimensions associated with the noun does not fully cover the data. For this reason, ACs are better understood in terms of maximality modifiers of extreme nouns.

6. Conclusion

This paper has argued that ACs are maximality modifiers of nouns like idiot. The latter have been analyzed as extreme predicates. That is, idiot-like nouns are gradable and denote extreme degrees. This means that their degree arguments have values above the relevant scale in the context. ACs modifying extreme nouns behave only partially as maximizers because of the type of maximum those nouns provide. In particular, the set of degrees off the relevant scale constitute a sort of maximum, but the degrees in that interval are undifferentiated to one another.

Providing an analysis of ACs as maximizers has reinforced the parallelism between adverbial and adjectival modification and unraveled the ways in which nouns can be gradable and the significance of scale structure in their semantics. Nevertheless, gradability in the nominal domain is still a controversial issue and its connection to evaluativity and subjectivity is not fully understood. Exploring other instances of evaluative nouns, such as expressive variants (quack as the variant of doctor), ethnic slurs or nouns formed by an affective suffix (e.g., Spanish politi-castro ‘politician. PEJ’), their contribution to the expressive dimension of meaning (Potts, 2005; Gutzmann, 2013), and their combination with adnominal degree modifiers may shed light in that direction.

References


Extreme nouns and maximizers


Some kind of relative clause
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Abstract. Amount Relatives (ARs) differ from restrictive relative clauses in that they do not refer to a particular object denoted by the head of the relative clause, but to an amount of such objects (Carlson, 1977a; Heim, 1987). Traditionally, ARs have been regarded as degree expressions. In this paper I argue against this view and propose instead that amount interpretations of relative clauses are in fact a special case of kind interpretation.

Keywords: kind reference, amounts, relative clauses.

1. Introduction

This paper is concerned with Amount Relatives in English, relative clauses that receive quantity-oriented interpretations (Carlson, 1977a; Heim, 1987; Grosu and Landman, 1998, 2017; Herdan, 2008; McNally, 2008; Meier, 2015). Consider the following example, minimally adapted from Heim (1987: 38).

(1) It would take us years to drink the champagne they spilled that evening.

The sentence in (1) is ambiguous. On its ordinary interpretation, the relative clause picks out the particular champagne that was spilled that evening, and the sentence on the whole is about the time it will take to drink that spilled champagne. This is the meaning we arrive at when, following the traditional analysis (Quine, 1960; Partee, 1973), we interpret the relative clause by intersecting the predicate denoted by the head noun with the extension of the that-clause. But this is not the most accessible interpretation of the sentence. On its most salient reading, (1) refers to the task of drinking the amount of champagne that was spilled that evening. In this case, the particular champagne that was spilled is not the object of the drinking; rather any champagne in the same amount will suffice. The examples below provide similar cases. Under the relevant interpretation, they all make a claim about an amount, not about an object.

(2) a. Mary saw the birds in thirty minutes that John saw in a day. (Meier, 2015)
   \sim Mary saw the number of birds that John saw

b. We lost the battle because we lacked the soldiers our enemy had. (McNally, 2008)
   \sim We lacked the amount of soldiers that our enemy had

c. The money it cost could have fed many people. (Grosu and Landman, 2017)
   \sim The amount of money it cost

Because of their semantic ability to refer to amounts, these relative clauses were named “Amount Relatives” by Carlson (1977a); I will refer to them as ARs henceforth.

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Historically, analyses of ARs have assumed that degree semantics should be invoked, in some form or other, in order to derive their amount interpretations. Picking up on Carlson’s idea that the work of extracting an amount should be done at the CP level, the received view has it that in ARs the embedded CP is a degree expression, denoting either a set of degrees or a maximalized degree (Heim, 1987; von Fintel, 1999; Grosu and Landman, 1998, 2017; Herdan, 2008; Meier, 2015). That is, the amount interpretation is the result of some “amount construction”, according to which the CP in (3) should be treated as a degree predicate–involving degree abstraction at the CP level. For instance:

(3) It would take us years to drink the champagne \[ \text{ they spilled that evening} \]
\[ [\text{CP}] = \lambda d \cdot \text{they spilled} \text{-MUCH} \text{champagne that evening} \]

The CP being degree denoting, these analyses come with the consequence that ARs should show all the properties of other bona fide degree constructions, such as comparatives, equatives, degree questions, etc.

In this paper I provide a radically different approach to ARs. First, I show that there are a number of parallelisms between ARs and relative clauses with \textit{kind} interpretations, which are unexpected on a degree-based account of ARs. Then, I bring a series of arguments against a degree-based analysis of ARs: contrary to what is expected, ARs do not show any of the hallmark features of well-established degree constructions. From these two sets of facts I conclude in favor of a uniform analysis of kind and amount relatives and against a degree-based approach to their semantics. In the proposal I will advance, amount interpretations \textit{are} a form of kind interpretation. Consequently, whenever a relative clause admits an amount interpretation, it also necessarily allows a kind interpretation. This is captured by the following generalization:

(4) The \text{AMOUNT} \subseteq \text{KIND} generalization:
Amount interpretations of relative clauses are a form of kind interpretation.

2. Amount Relatives in perspective

2.1. Main properties of ARs

There are three main semantic properties of amount interpretations that set them apart from ordinary object-referring (intersective) interpretations. The first and most obvious is that they refer to amounts, not objects. This poses a general challenge: in spite of being DPs of the form \textit{the NPs}, amount interpretations do not refer to that NP. The flip-side of this property is that the NPs heading the relative clause in (1) and (2) cannot be interpreted as definites, but as indefinites, in spite of the presence of the definite article. For instance, in (1) there is no single individual object-level champagne that would take us long to drink; in fact, any champagne in the relevant amount suffices. The last distinguishing property of amount interpretations is that they always involve a comparison of two amounts of the same stuff. To appreciate this requirement better, consider first a classifier relative clause with an overt noun \textit{amount}. 

164 Jon Ander Mendia
(5) It would take us years to drink the amount of champagne that you drank of wine.

What (5) shows is that relative clauses headed by the noun amount allow the comparison of two different instances of stuff; in (5) the comparison is between amounts champagne and wine. The same, however, is not possible with ARs.

(6) *It would take us years to drink the champagne that you drank wine.

To ensure that this restriction is not syntactic, we can use sentences that are grammatical but lack an amount interpretation in the relevant environments. Consider (7):

(7) [Context: I drank two liters of champagne in 3 hours, and you drank two liters of wine in 30 minutes.]

It took me 3 hours to drink the champagne that you drank in 30 minutes.

Despite its grammaticality and the supportive context, (7) would be deemed false in this situation. This points out that, unlike for (5), comparing amounts of different stuff is not possible for relative clauses like (1) and (7).

Summing up, any theory that aims at accounting for amount interpretations of relative clauses should capture these three empirical facts, summarized in (8) and paraphrased in (9) for clarity:

(8) a. **Definiteness:**
   Amount interpretations refer to a definite amount, not a definite individual.

b. **Indefiniteness:**
   The head of the relative clause is interpreted as an indefinite.

c. **Identity:**
   Amount interpretations require a comparison of two amounts of the same stuff.

(9) [[It would take us years to drink the champagne they spilled that evening] \( \equiv (1) \)]

2.2. A notable parallelism

The properties of amount interpretations discussed above have been known since Carlson (1977a, b). Carlson also noted that relative clauses allowing for amount interpretations can be kind-referring as well. Consider a minimal variant of (1):

(10) It will take us the rest of our lives to find the champagne they spilled that evening.

On its most salient interpretation, (10) receives a form of kind interpretation–biased by the change of verb from drink to find. For instance, it could be that the champagne is difficult to find because it is very rare. This is only one of many possible reasons; it could also be that
there is a high demand of that particular kind of champagne, that it is not usually imported to our country, etc.² All these interpretations have the same properties of amount interpretations described in (8). For one, the sentence does not refer to a particular champagne, despite being overtly of the form the champagne that... This is precisely the condition on indefiniteness of the head of the relative clause described in (8). Similarly, the sentence refers to a definite kind of champagne, the precise kind of champagne that they spilled that evening. This is, again, fully parallel to the condition on definiteness described in (8). Finally, notice that we are not at liberty to choose what is the thing that would take us the rest of our lives to find; it must be champagne. This is the same identity restriction that we observed in (8) for amount interpretations. To appreciate the parallelism between kind and amount interpretations in full, consider the following equivalent of the paraphrase in (9).

(11)  [It would take us years to drink the champagne that they spilled that evening] ↔ It would take us years to drink champagne of that kind [where that kind = the kind of champagne that they spilled that evening]

The conclusion is clear: the facts in (8) are not exclusive of amount interpretations alone.

2.3. Further similarities

There a number of further parallelisms between kind and amount interpretations of relative clauses, suggesting that the connection between the two is not spurious. First, both kind and amount interpretations seem to be a particularity of the definite article.

(12)  It would take us years to {find/drink} {the / *a / *some / *few / *two} champagne that they spilled that evening.

Second, the two interpretations are generally incompatible with the complementizer which:

(13)  It would take us years to {find/drink} the champagne {that / ∅ / *which} they spilled that evening.

Third, amount interpretations of relative clauses do not obligatorily rely on the presence of a relative clause, and with sufficient contextual support, it may be dropped altogether. Thus, both amount and kind interpretations are possible with nouns modified by PPs.

(14)  a. We lost the battle because we didn’t have the soldiers of the Imperial Army.
     b. We used to organize a soccer team, but we don’t have the students in the department anymore.

²This type of interpretation is sometimes referred to as an “extent” reading, which goes beyond what we usually think of taxonomic kinds. I will continue to call it simply a “kind” interpretation for consistency, but it should be clear that this interpretation is in fact richer than a well-established kind.
For instance, the sentence (14a) might refer to the fact that the reason for losing the battle was that we did not have as many soldiers as the Imperial Army did. This is the amount interpretation. Alternatively, it could be that despite having more soldiers than the Imperial Army, ours are poorly trained, lack motivation, etc. This is the kind interpretation (see fn.2). Similar interpretations are available with bare DPs as well.

(15)  
   a. We lost the battle because we didn’t have the soldiers.
   b. We used to organize a soccer team, but don’t have the students anymore.

Thus, in all three cases we observe that the relationship between the availability of the two interpretations is preserved. More importantly, the presence of amount interpretations in (14) and (15) is puzzling from a perspective where they require a degree variable originating in a subordinate position, as is usually assumed with ARs.

The upshot of this discussion is that we have two types of interpretation, kind and amount, showing the same signature effects, and similar syntactic constraints, distribution and availability. These parallelisms and the fact that kind-reference typically does not involve degrees raise the question: Are we justified in appealing to degree semantics to account for amount interpretations? Minimally, in doing so we would miss a generalization, namely, that amount and kind interpretations of relative clauses share the key semantic properties that make ARs stand out and behave unlike intersective relative clauses. In what follows, I show that not only does appealing to degrees miss a generalization, it also makes the wrong empirical predictions.

3. Doing without degrees

This section examines whether so-called ARs behave as bona fide degree constructions. The results of this examination have already been foreshadowed before: if we take comparatives, equatives, etc. as the quintessential degree constructions involving a relative clause and degree abstraction at the CP level, amount interpretations of relative clauses do not behave alike.

3.1. Sub-deletion

The process known as sub-deletion is considered a hallmark of degree abstraction (Kennedy, 1999; Lechner, 2001). For instance, comparatives and equatives all allow sub-deletion.

(16)  
   a. I brought more bananas than you brought apples.
   b. I brought as many bananas as you brought apples.

Classifier Relatives also allow sub-deletion. In contrast, relative clauses with amount interpretations never allow sub-deletion.

(17)  
   a. I brought the \{ amount / quantity \} of bananas that you brought of apples.
   b. *It will take us years to drink the champagne that they spilled wine that evening.
The lack of sub-deletion properties of (17b) points towards a fundamental difference in how the amount interpretations arise in (16)/(17a) and (1)/(2). Thus, we fail to find the expected parallelism between canonical degree constructions and ARs.

3.2. Islands

The second argument is the lack of island effects with relative clauses that permit an amount interpretation. There is a subset of syntactic islands, the so-called weak or sensitive islands, which only allow extraction of certain grammatical expressions: expressions ranging over individual entities are good extractees, as opposed to expressions ranging over other domains, like degrees, times, manners, etc., which often incur in so-called island violations. If relative clauses require degree abstraction to obtain amount interpretations, they should pattern together with other constructions that involve the same operation in showing weak-island sensitivity, much like comparatives, equatives and how many questions. By the same token, relative clauses with an amount interpretation should contrast with individual who questions, which involve abstraction over individuals, and are able to be extracted from weak islands.

Below, I examine the behavior of e-denoting vs. d-denoting wh-words in negative islands as a baseline, and compare this with the behavior of comparatives, equatives and relative clauses.\(^3\) The interaction between degree operators and negative and other downward entailing operators was noted early on the works that pioneered degree semantics for the study of comparative constructions (see von Stechow, 1984). An influential view popularized by Rullmann (1995) attributes the ill-formedness of the (18) examples below to the impossibility of maximalizing a set of degrees that contains a negative operator in its scope.

\[(18)\]
\[
a. \text{*How many soldiers doesn’t the Imperial Army have?} \\
b. \text{*We have more soldiers than the Imperial Army doesn’t have.} \\
c. \text{*We have as many soldiers as the Imperial Army doesn’t have.}
\]

The ungrammaticality of the previous examples contrasts with the grammaticality of cases where the extractee lives in the domain of individuals, such as which and what.

\[(19)\] Which soldiers doesn’t the Imperial Army have?

If we look at relative clauses with amount interpretations, we observe that they pattern like (19) and unlike the examples in (18) above. Many speakers readily admit an amount reading of (20): it amounts to saying that our soldiers exceeded in number those of the Imperial Army.\(^4\) (As expected, out of the blue, the kind interpretation of (20) is also available.)

\(^3\)Due to space limitations, I only discuss the case of negative islands, but the same observations hold of others, such as tenseless wh-islands, a variety of factive constructions, etc.

\(^4\)Some speakers may need some more contextual support. Suppose that our school is competing against others to get some fellowship. In order to get the fellowship there are certain stringent constraints on how many students schools may have, such that having a certain number of students may maximize your chances of obtaining the fellowship. In this case, a sentence like our school got the fellowship because we had the students that yours didn’t have expresses that we had an amount of students such that your school did not have as many students.
3.3. Interim conclusion

In the last two sections, I demonstrated both that (i) there is an undeniably similarity between amount relatives and kind-referring relatives and (ii) unexpected differences between amount relatives and other degree constructions. These facts suggest that a unified treatment of kind and amount relatives is not just defensible, but desirable. Therefore, I propose the generalization in (4), where amount readings are ultimately derived from kind readings.

(4) The $\text{AMOUNT} \subseteq \text{KIND}$ generalization:
Amount interpretations of relative clauses are a form of kind interpretation.

4. What kinds and amounts have in common

The goal of this section is to spell out a formal account of the generalization in (4). The general intuition that I will pursue, in a nutshell, the following. The relative clauses we have discussed so far make reference to subkinds. The head noun of the relative clause provides the name of a kind that we can then reference and attribute properties to. The kind interpretations prompted by relative clauses in (1) and (2) highlight some relevant property that holds of the referent of the relative clause. This property is used to attribute to the kind-referring term the sufficiently regular behavior that it requires to be understood as kind-referring. Paraphrasing:

(21) a. It would take us years to drink the champagne that they spilled last night.
    $\rightsquigarrow$ It would take us years to drink champagne with some relevant property of the champagne we spilled last night

b. $[\text{DP the champagne that we spilled last night}] \leftrightarrow \text{champagne with property } P$
   [where “the champagne that we spilled last night” is a realization of $P$]

Since the relevant property $P$ that serves to single out the referred kind is unspecified, it could be anything that is supported by the current circumstances, and so it may well be a gradable property like $be\ d\text{-dry}$, and $be\ d\text{-much}$, as well a non-gradable property, like $be\ produced\ in\ Alsace$, or a more common taxonomic property of champagne-kinds, like $be\ a\ prestige\ cuvée$. In this way it is possible to capture amount interpretations of relative clauses like (1)/(2) by the same means required to account for kind reference. It is in this sense that amount interpretations can be taken to be a form of kind interpretation and that a unified account is possible. As a consequence, whenever a relative clause admits an amount interpretation it also necessarily allows a kind interpretation. This way of looking at sentences like (1)/(2) captures their overall vagueness—i.e. the champagne that was spilled could have any number of properties bearing on the time it would take us to drink an equivalent champagne. The key unifying factor, however, is that the property $P$ contributes a way of narrowing down the space of possibilities for the subkind in question.
4.1. On kinds and subkinds

Although definite DPs cannot typically be used to form generic statements in English, there are specific environments where the definite article can be used to make reference to a kind. Consider (22), where a kind-referring term is further restricted by the use of an anaphoric demonstrative or a relative clause. In these examples, the head noun “kind” is optional, suggesting that the definite article is not altogether ruled out from kind-referring terms.

(22) a. This (kind of) lion is widespread.
   b. This (kind of) whale is extinct.
   c. The (kind of) lion that eats people is widespread.
   d. The (kind of) whale that had horns is extinct.

Crucially, the sentences in (22) refer to subkinds of lions and whales, as opposed to the natural kinds on the whole. Moreover, subkind-referring expressions like those in (22) need not be natural or well-established; they can be ad-hoc. This is easily seen in (22c): the lions that eat people, for instance, do not form a natural class; in fact, they may comprise of individual lions in several subspecies of lion and exclude others in the same subspecies.

Chierchia (1998) thought of kinds as regularities that occur in nature, whose only property is that “we can impute to them a sufficiently regular behavior”. Ad hoc subkinds allow us to do something similar in real time, that is, impute a regular behavior to some subset of a kind without prior agreement as to whether the behavior in question actually qualifies as sufficiently regular. This is a very useful mechanism if, with Chierchia, we believe that what counts as kind is not set by the grammar, but amounts instead to conventional (shared) knowledge of a community of speakers. It allows us to talk and ask questions about very specific kinds. These examples help to pinpoint what we need to form an ad hoc subkind: (i) a semantic sortal—something to be a kind of—, and (ii) some means to identify what the relevant subkind is. (i) is provided by a kind-referring noun. Anaphoric demonstratives, relative clauses (and sometimes PPs and other modifiers like adjectives) can accomplish (ii). The analysis I defend here capitalizes on the possibility of constructing ad hoc subkinds and the grammaticality of the definite article when making reference to such subkinds.

4.2. Ad hoc subkinds as partitions

Referencing subkinds, ad hoc or not, is not completely free. Carlson (1977a) noted that when referring to different subkinds, the subkinds must be disjoint, they cannot share realizations. A sentence like (23) cannot be verified by a situation where only Fido is sitting in the next room, even though Fido in fact belongs to more than one kind of dog (e.g. if he is a watch dog and a border collie in the real world, he effectively belongs to two different subkinds of dog).

(23) Two kinds of dogs are sitting in the next room.

Carlson (1977b: 213) spelled out the constraint as follows (slightly adapted here):
**Disjointness Condition**: A kind-referring expression can only refer to a contextually defined subset of all the possible subkinds that the noun is true of, such that:

a. the subkinds in this subset are disjoint and share no realizations,

b. the subkinds collectively cover all the space of realizations of the kind.

In order to make the connection between *ad hoc* subkinds and amount interpretations maximally salient, I will recast Carlson’s (1977b) disjointness condition in terms of partitions. I suggest that reference to subkinds must be mediated by an equivalence relation that induces a partition on the denotation of its relevant superkind. How this equivalence relation is determined is context dependent; as a consequence, part of the task when interpreting an *ad hoc* subkind referring expression involves retrieving this equivalence relation from the context.

Following Cresswell (1976), Klein (1980) and many others, degrees can be understood as equivalence classes of ordinary objects. That is, the degree of my height can be defined by the set things that are the same height as me, an amount of champagne as the set of portions of liquid of equal volume, etc. Because interpreting *ad hoc* subkinds involves figuring out what the equivalence relations are, and because some equivalence relations can serve to define degrees, there is no reason why *ad hoc* subkinds should not make reference to portions of equal amounts, just like they can refer to sets of entities (*qua* kinds). Coming back to the example in (21) above, we could say that the equivalence relation be the same kind as would give us a partition of champagne individuals according to their kind (e.g. blanc de noirs, blanc de blancs, rosé champagne...). The equivalence relation be as sweet as would partition the domain of champagne in terms of the sweetness of its instances (extra brut, brut, extra dry...), whereas an equivalence relation be as much as would partition the denotation of champagne in different amounts (1L, 2L, 3L... or perhaps 1 bottle, 2 bottles, 3 bottles...).

Let us look first into partitions. A partition is a way of dividing some set into disjoint subsets. More interestingly for us, the partitioning of a set can be carried out by an equivalence relation, which is a reflexive, symmetric and transitive relation. If \( R \) is an equivalence relation, \( [x]_R \) represents the equivalence class containing \( x \). An equivalence class simply collects in a set all the elements that are equal with respect to some equivalence relation. Thus, if \( y \) is also a member of \( [x]_R \), then \( [x]_R = [y]_R \). Each subset that is a member of some partition is called a *cell*. An equivalence relation \( R \) is able to induce a partition on a set \( A \), because any two members \( x \) and \( y \) can only be in the same cell if (and only if) they are related by \( R \).

\[
\begin{align*}
\text{a. Partition:} & \quad \text{Let } A \text{ be a non-empty set. A partition is a collection of subsets of } A \text{ iff} \\
& \quad (i) \text{ for any two subsets } X \text{ and } Y, X \cap Y = \emptyset \text{ and } (ii) \text{ the union of all subsets of } A \text{ equals } A. \\
\text{b. Equivalence Relation:} & \quad \text{Let } R \text{ be an equivalence relation. Then:} \\
& \quad a \sim_R b \iff \forall x \big( (R(a,x) \iff R(b,x)) \land (R(x,a) \iff R(x,b)) \big) \\
\text{c. Equivalence Class:} & \quad \text{Let } [ ]_R \text{ be a function from a domain } D \text{ to } \text{POW}(D) \text{ such that:} \\
& \quad \forall x \in D \big[ [x]_R = \{ y : y \in D \land x \sim_R y \} \big]
\end{align*}
\]

Let us return to Fido in (23). Given the equivalence relation be the same breed as, Fido is a member of the cell containing border collies, the equivalence class \([F]_{breed}\). By the same token,
if the equivalence relation were *have the same role as*, Fido would be in the cell containing watch dogs. \([F]_{role}\). Given the properties of partitions, Fido cannot live in two cells at the same time, and so we have to chose one or the other equivalence relation. Hence the ill-formedness of (23).

We can now look into how to extend the partition talk to degrees. I follow Cresswell (1976) in assuming that degrees can be viewed as equivalence classes of individuals (see Klein, 1980; Rullmann, 1995). I illustrate the main idea with an adjective \(A\). Associated with any gradable predicate (an adjective, adverb, verb, etc.) there is a two-place relation \(\geq_A\), and a set \(D_A\). The set \(D_A\) is a subset of the universe of discourse containing all and only those objects of which the adjective can be sensibly predicated. This is just a lexical requirement to make sure that a set like \(D_{tall}\) contains people, mountains, etc., but not ideas or colors, since the latter cannot be sensibly attributed a height. The relation \(\geq_A\) is reflective of our conceptual ability to determine, from any two individuals, which has more of a certain quality than another. Cresswell (1976) suggested to define \(\geq_A\) as follows:

\[
\langle D_{tall}, \{ \langle x, y \rangle : x, y \in D_{tall} \text{ and } x \text{ is as tall as } y \} \rangle
\]

From here the relation \(\geq_A\) may induce a totally-ordered relation \(\geq_A\) on the members of \(DEG_A\) such that \(deg_A(x) \geq_A deg_A(y)\) iff \(x \geq_A y \wedge y \geq_A x\). In this case, we can easily define an equivalence relation from \(\geq_A\), and partition a domain according to the resulting equivalence relation, where the degree of \(A\)-ness of an object \(x\), say \(deg_A(x)\) is defined as the set of all objects that stand in the \(\equiv_A\) relation to \(x\):

\[
\begin{align*}
(27) \quad & \text{a. } x \equiv_A y \iff x \geq_A y \wedge y \geq_A x \\
& \text{b. } deg_A(x) = \{ y \in D_A : x \equiv_A y \}
\end{align*}
\]

As a consequence, the degree to which Liz is tall, \(deg_{tall}(Liz)\) can now be identified with the set of all objects that are exactly as tall as Liz. In this view, each degree \(d\) corresponds to one of the cells in the partition \(DEG_A\) induced on the set \(D_A\). For instance, in the case of \(DEG_{tall}\) (and a very reduced domain) we may have:

\[
(28) \quad \begin{array}{l}
d_{5.8j}: \text{John, Sue Liz} \\
d_{5.9j}: \text{Mary, Al} \\
d_{6j}: \text{Mike, Helen} \\
d_{6.1j}: \text{Hilary}
\end{array}
\]

Establishing partitions from pluralities works exactly the same. We only have to be careful to avoid overlapping individuals. That is, we must avoid that a plurality of two individuals \(a \oplus b\), living in the cell corresponding to those pluralities of cardinality 2, be also members of some other cell in the partition. For instance, one could expect that if \(a \oplus b\) teams up with individual \(c\) to form the plurality \(a \oplus b \oplus c\), then individuals \(a\) and \(b\) would simultaneously be in the cell corresponding to pluralities of cardinality 3 as well. The solution is to adopt a Link (1983) style approach to pluralities, where plural entities are just *sums* of individuals (and not sets), as concrete as the individuals that serve to define them and of the same logical

\[5\text{Notice that the thresholds of the degrees should be overtly determined, so that there is no vagueness whatsoever as to where exactly every individual belongs in the partition. In the example above the cut-off point was the nearest inch, so the actual equivalence relation should read be as tall as, to the nearest inch.}\]
type, creating a non-monotone domain of individuals. If a mapping exists between degrees and sets of individuals, as discussed above, each level in a Linkian structure can be seen as an equivalence class. Assuming that cardinalities are simply degrees, as it is common practice, we can create a partition $\text{DEG}_{\text{card}}$ on $D$ by the equivalence relation $\equiv_{\text{card}}$.

\begin{align*}
\text{(29)} & \quad \begin{align*}
a. & \quad x \equiv_{\text{card}} y \iff x \equiv_{\text{card}} y \land y \equiv_{\text{card}} x \\
b. & \quad \text{deg}_{\text{card}}(x) = \{ y \in \ast D : x \equiv_{\text{A}} y \}
\end{align*}
\end{align*}

[where $\equiv_{\text{card}}$ = a cardinality as big as]

The result is a partition of the domain of plural individuals according to their cardinality. For instance, the equivalence class $[a \oplus b]_{\text{card}}$ corresponds to all plural individuals of cardinality 2 in the domain, such that $[a \oplus b]_{\text{card}} = [a \oplus c]_{\text{card}} = [b \oplus c]_{\text{card}}$, etc. Because plural individuals are individuals with full rights, we need not look into their composing parts. That is, that $a$ and $b$ belong to one cell and $a \oplus b$ to a different cell is inconsequential in this respect.

4.3. Connecting the dots

In order to make the connection between ad hoc subkinds and amount interpretations of relative clauses explicit, we have to look a bit further into ad hoc subkinds. Ad hoc subkinds are inherently vague referring expressions. Although they refer to subkinds, they do not do so in a direct way. Compare:

\begin{align*}
\text{(30)} & \quad \begin{align*}
a. & \quad \text{The blue whale is becoming extinct.} \\
b. & \quad \text{The whales that you like so much are becoming extinct.}
\end{align*}
\end{align*}

One can refer to a subkind by directly mentioning its name. In this case, blue whale stands for a (taxonomic) subkind of whale. But very few subkinds have names. For all we know, the kind of whales that you like so much could be blue whales, but it could as well be almost any collection of whales that you fancy. That is, the subkind whales that you like so much are a subkind just by virtue of your liking them so much. In this case, then, the only “sufficiently regular behavior” that we may impute them is precisely that you like them so much.

I suggest that the sole role of the relative clause in ad hoc subkind reference constructions is to provide information that helps determine what the relevant sufficiently regular behavior is. How exactly does the relative clause fulfill this role? It does so by restricting, in more or less the usual way, the denotation of the kind-denoting NP, e.g. whale in (30b), to a subset of whales. Crucially, this subset must be a member of one cell in a partition of whale subkinds. Given the nature of partitions, information about one cell can help us fill in the rest of the cells; for instance, by lumping together in one cell the individual whales that you like, and all the ones that do not belong in this cell occupying the sole other cell of the partition. The more information we might have about your preferences, the richer the partition could be. Under this view, a critical part of resolving ad hoc subkind reference is being able to determine an equivalence relation that puts all the whales that you like in a single cell.
This is not always as straightforward as it may seem and, oftentimes, vagueness is rampant. In (1), *the champagne that we spilled last night* is referring to an *ad hoc* subkind of champagne. If we go with the taxonomic interpretation of the sentence, we partition the domain of champagne into its different subkinds, and we assume that the particular champagne that the spilled last night lives in one of the cells. For instance, if they spilled a very rare kind of *prestige cuvée*, we would require a partition based on taxonomic kinds.

(31) | Prest. cuvée | Blanc de noirs | Blanc de blancs | Rosé |
--- | --- | --- | --- | --- |

Each one of the cells above contains the individual instances of champagne that correspond to each kind. Carlson’s (1977a) disjointness condition is met by resorting to an equivalence relation like *be the same kind as*. Now, it could be that the reason why it would take us so long to find the champagne that we spilled last night is because it was much sweeter than usual. In that case, we can generate the relevant partition by sweetness–gr. of sugar per liter–from an equivalence relation like *be as sweet as*.

(32) \[ d < 6 \quad 12.1 < d < 17 \quad 17.1 < d < 32 \quad 32.1 < d < 50 \quad \ldots \quad d < \ldots \]

To reiterate: subkind reference must be mediated by a partition to ensure that the domain is covered by non-overlapping sets. This partitioning is carried out by an equivalence relation that is only contextually determined. As long as this is observed, any equivalence relation might do. Thus, the only difference between (31) and (32) above is that different equivalence relations are picked in different contexts. At this point, it is straightforward to extend the same reasoning to the classical AR examples and amount interpretations. Since we know that cardinalities can be defined in terms of equivalence classes, there is no reason why the required equivalence relation cannot be of the form *be as much as*. Thus, for the classical *champagne* example in (1), we could envision a partition by volume, as in (33).

(33) \[ 0L \leq d < 1L \quad 1.1L < d < 2L \quad 2.1L < d < 3L \quad 3.1L < d < 4L \quad 4.1L < d < 5L \quad \ldots \quad d < \ldots \]

If this rationale is correct, amount interpretations of relative clauses are simply a case of *ad hoc* subkind reference. Thus, the only analysis we need is one that derives *ad hoc* subkind reference, and no appeal to degree semantics is necessary.

To sum up, making reference to subkinds requires structuring the domain in a certain way. I argued that one way of capturing this requirement is by partitioning the relevant domain. Once this step is taken, a parsimonious account of amount interpretations of relative clauses is made available. Because degrees are definable in terms of equivalence classes, we can exploit the independently-needed mechanisms of *ad hoc* kind reference and induce a partition that gives us equivalence classes of quantities or amounts. Given the evidence in sections §2 through §3, this account offers a number of advantages: (i) it accounts for the pervasive similarities between kind and amount referring relative clauses in terms of their the syntactic/semantic properties, (ii) it accounts for the lack of evidence for degree abstraction, and (iii) it relies on mechanisms

---

6In this respect, the table above is just a shortcut to the actual partition, whose members are always individuals, not kinds.
that are independently needed for the interpretation of subkind-referring expressions, as well as extant analyses of degrees as equivalence classes.

5. Compositional implementation

In laying out my assumptions about kind reference I am following Chierchia (1998) for the most part. Kinds are individuals whose spatiotemporal manifestations are discontinuous. In this sense, the kind \textsc{dog} can be identified as the sum of all individual dogs, which can then be modeled as the largest member of the plural individual comprising all dogs. For the majority of properties, like the property of being a dog, there is a corresponding kind, the dog-kind. Conversely, natural kinds have a corresponding property (the property of belonging to that kind). Properties may be systematically mapped to their individual correlates via a nominalization function, the “down” operator \( \cap \). Likewise, individual kinds may be mapped to their corresponding properties via the inverse of \( \cap \), the “up” operator \( \cup \).

\begin{equation}
\begin{aligned}
(34) & \quad \text{a. Predicativization: Let } d \text{ be a kind. Then for any world/situation } s, \cup d = \lambda x. \leq d_s, \\
& \text{if } d \text{ is defined, false otherwise (where } d_s \text{ is the plural individual that comprises all of the atomic members of the kind).} \\
& \text{b. Nominalization: For any property } P \text{ and world/situation } s, \cap P = \lambda s. \tau P_s \text{ if } \lambda s. \tau P_s \\
& \text{is in } K; \text{ else undefined (where } P_s \text{ is the extension of } P \text{ in } s \text{ and } K \text{ is the set of kinds).}
\end{aligned}
\end{equation}

Kinds are individuals with their own rights, and so they belong to their own domain \( D_k \), a subset of \( D \). Thus, we can talk about the domain of object-individuals \( D_o \), to the exclusion of the domain of kind individuals, \( D_k \). Kinds have the possibility to combine both with kind-level and with object-level predicates. In the first case, kinds are attributed some property directly by the main predicate, (35a). In the second case, most commonly with episodic sentences, we encounter a mismatch between a kind denoting argument and a predicate that lexically selects for non-kind predicates, (35b).

\begin{equation}
\begin{aligned}
(35) & \quad \text{a. Dogs are } \{\text{widespread/extinct/common}\}. \\
& \text{b. Dogs are barking outside my window.}
\end{aligned}
\end{equation}

Example (35a) is a case of direct-kind reference: to derive this interpretation, we simply apply the kind denoting term to the predicate, e.g. \texttt{extinct} (\textsc{dog}). The example in (35b) is different in that the dog-kind now serves as an argument to an individual-selecting predicate. In this case, the predicate does not attribute properties to the dog-kind, but to object-level instances of the dog-kind; (35b) asserts the existence of some individual dog that is barking. To achieve this result, Chierchia (1998) proposes a new rule of composition, Derived Kind Predication (DKP henceforth), that solves two problems: it provides a means to solve the sortal mismatch and introduces existential quantification over instances of a kind.

\footnote{In order to represent kinds and object variables, I follow the convention of using the subscripts \( k \) for kind-level and \( o \) for object-level variables.}
(36) a. Derived Kind Predication (DKP):
If \( P \) applies to objects and \( k \) denotes a kind, then \( P(k) = \exists x[\cup k(x) \land P(x)] \)
b. \([ (35b) ] = \exists x[\cup(\lambda x.\textit{dog}(x) \land \textit{barking-outside-my-window}(x))] = \exists x[x \leq \textit{DOG} \land \textit{barking-outside-my-window}(x)]\)

The next step in arriving at the desired \textit{ad hoc} subkind interpretations involves a mapping from kinds to subkinds.

8 In accordance with the discussion above, however, we need a mapping that will partition kinds, not just any subkind extracting operation. The partition function below meets these two criteria (cf. Gillon, 1987; Schwarzschild, 1996): a partition of a kind \( K \) is a set of subsets of \( \cup K \) that covers \( \cup K \) and whose members do not share any instantiating individuals.

(37) **Partition function**: A partition function \( \prod \) is a \( (k,kt) \) function such that for any kind \( K \), \( \prod(K) \) meets two conditions:

a. **Cover**: \( \forall x_0[x_0 \leq K \rightarrow \exists y_k \in \prod(K)[x_0 \leq y_k]] \)
b. **No overlap**: \( \forall x_0[\exists y_k \in \prod(K)[x_0 \leq y_k] \rightarrow \neg \exists z_k \in \prod(K)[y_k \neq z_k \land x_0 \leq z_k]] \)

As an illustration, consider the case of \( K = \textit{DOG} \), where we partition the dog-kind taxonomically (i.e. \( \prod(\textit{DOG}) = \{\textit{COLLIE}, \textit{PUG}, \textit{GREYHOUND}, \textit{BEAGLE}, \ldots\} \)). Then condition (a) states that if \( x_0 \) is an instance of the kind \( \textit{DOG} \), there is some subkind \( y_k \) in the set of subkinds \( \prod(\textit{DOG}) \) that \( x_0 \) is also an instance of. This condition makes sure that all particular dogs belong to some subkind, to some breed in this case. In turn, condition (b) states that if \( x_o \) is an instance of the subkind \( y_k \), there will be no additional subkind \( z_k \) in \( \prod(\textit{DOG}) \) such that \( x_o \) also realizes. This is reflective of the fact that, if Fido is a beagle, he cannot be any other breed. More generally, the function ensures that if we partition the dog-kinds by breed, all border-collies will be in the same cell of the partition, and, say watch-dog border-collies will not be able to occupy their own–despite being a subkind of dogs as well in the actual world.

We can now use the partition function in (37) to provide a compositional account of \textit{ad hoc} kind-referring terms. First, a kind must be partitioned into a set of individual correlates of its subkinds. We can do this by defining a kind-to-subkind operator that employs the partition function (cf. Zamparelli, 1998). Call this operator \( \kappa \).

(38) \[ \kappa = \lambda x_k.\lambda y_k. \prod(x_k)(y_k) \]

From a semantic standpoint, we can think of \( \kappa \) as doing covertly the task that the noun \textit{kind} does overtly. It targets a kind \( x_k \) and returns a set of kind-individuals that partitions \( x_k \). The function returns the set of (individual correlates of) subkinds that are in the partition.

(39) \[ \kappa(\textit{DOG}) = \lambda y_k. \prod(\textit{DOG})(y_k) = \{\text{GREYHOUND, BORDER COLLIE, BEAGLE, \ldots}\} \]

In this case, we have partitioned the domain of \textit{DOG} subkinds according to their taxonomy, making sure on the way that no one dog belongs to two separate kinds. So far we have suc-

---

There are a number of mappings in the literature between kinds and subkinds (e.g. Krifka et al., 1995; Wilkinson, 1995; Zamparelli, 1998), usually carried out by an operator, whose meaning is generally taken to be very similar to the noun \textit{kind} in expressions like \textit{kind of dog}. 
cessfully reproduced Carlson’s (1977a) results, but we have not quite achieved our goal of accounting for ad hoc kind reference. As I suggested earlier, two pieces of information are required in order to form an ad hoc kind in real time: (i) a semantic sortal—something to be a kind of—, and (ii) some means to identify what the relevant subkind is, i.e. to identify its sufficiently regular behavior. This is shown by the contrast between the two sentences in (40):

(40) a. That kind of dog is dangerous.
   b. *The kind of dog is dangerous.

In the two cases in (40) the semantic sortal is provided by the kind-referring noun dog, but only (40a) provides a means to identify the relevant properties of the dogs that are to be recognized as dog-subkinds; in this case it does so by anaphorically referring to it. The variant in (40b) lacks this second piece of information and reference to a kind fails.

A similar state of affairs holds in the absence of the noun kind. When no natural kind nor an antecedent for the intended subkind is available, we can use the NP Rel Clause constructions to refer to ad hoc kinds. This is because the relative clause itself can express a regularity that characterizes the kind in question, thus aiding in kind reference resolution. With kind-referring terms involving the noun kind, the role of the relative clause is obvious. But given our analysis of the κ-operator, the role of the relative clause in ad hoc kind reference without the noun kind should follow analogously.

In order to capture this difference formally we can think of the relative clause as a means to further narrow the kind-referring potential of kind-referring NPs. It is in this respect that appealing to partitions becomes specially useful. We can easily modify κ so that it makes reference to an additional argument, a predicate P, and states a new condition whereby objects in the intersection of P and the property correlate of the kind K all live in the same cell of some partition of K. This can be done as follows. Consider first a revised version of κ, κ+.

(41) \[ [\kappa^+] = \lambda x_k . \lambda P_{(et)} . \lambda y_k . \Pi (x_y (y_k)) \land \forall z_o [z_o \leq x_k \land P(z_o) \rightarrow z_o \leq y_k] \]

After applying to an individual kind \(x_k\) and a property \(P\) of individuals, \(\kappa^+\) returns the subkinds that include objects whose realizations are both instances of \(x_k\) and members of \(P\). The task of \(P\), the relative clause, is to provide information about the regular behavior that we must impute to the subkind in question. This is achieved by letting the relative clause do its usual job and interpreting it intersectively.

Let us work out a concrete example, the lions that eat people, from (22c). The term lions that eat people refers to a kind, but not to a natural or well-established one, so this is a task for \(\kappa^+\). For concreteness, assume a syntactic structure along the lines in (42). By the time \(\kappa^+\) gets to enter into the derivation, the NP already denotes a kind.9

9There a number of ways of doing this (see e.g. Carlson, 1977b; Zamparelli, 1998; Dayal, 2004; Kratzer, 2005). Bear in mind however that different options entail different views of how nouns come to denote kinds. At any rate, this is a simplifying assumption, and nothing about how ad hoc kind-referring terms are derived hinges on this decision.
The last line above returns a set of subkinds of the lion-kind that partitions the domain of lions and where all the object-level lions of which \( P \) holds constitute an instance of one such kind. This is still too weak a meaning. But now the definite article can simply contribute an \( \iota \)-operator:

\[
\iota y_k. \Pi(LION)(y_k) \land \forall z_o[z_o \leq LION \land P(z_o) \rightarrow z_o \leq y_k]
\]

The article applies to the set of subkinds of lions denoted by NP1 and returns the single salient subkind of which all the people-eating lions are an instance, i.e. the individual correlate of the property \textit{be a people-eating lion}.

As a consequence, non-people-eating lions and lions that eat other things besides people will have to live in other cells of the partition.

It follows, then, that the cells in the partition cannot contain taxonomic subkinds anymore, since no partition of lions in terms of their subspecies will contain the \textit{ad hoc} subkind of lions that eat people in one its cells. Thus, as desired, this method of referencing \textit{ad hoc} subkinds overrides any other natural ways of picking the relevant subkinds (e.g. taxonomic properties, etc.). The most likely way to complete the rest of the partition is to find a suitable equivalence relation that groups all people-eating lions in the same cell. An equivalence relation \textit{eat the same as} might do. With this equivalence relation we may obtain a partition of the lion-kind like the following.

\[
\{ \text{LIONS THAT EAT PEOPLE}, \text{LIONS THAT EAT ZEBRAS}, \text{LIONS THAT EAT CARRION} \ldots \}
\]

What matters most is that the modifier, the relative clause in this case, is informing us about what one of the subkinds must look like. The resulting DP can serve as an argument to kind-level predicates in the usual way. Alternatively, it can serve as non-kind-selecting predicates via Derived Kind Predication (see (36a) above): a sentence like (46a) asserts the existence of an instantiation of the \textit{ad hoc} eating-people-lion-kind, and that you like (some of) those instantiations.

\[
(46)\begin{array}{ll}
\text{a.} & \text{You like the lions that eat people.} \\
\text{b.} & [\text{(46a)}] = \exists y[\forall(\lambda z.*\text{lion}(z) \land \text{eat people}(z))(y) \land \text{like}(y)(\text{you})]
\end{array}
\]

Notice that, practically speaking, (46a) may be interpreted in a number of ways. This is because the semantics of \( \kappa+ \) only forces us to find a partition of lions where the lions that eat people live in one cell, but it does not force us to talk about the fact that these lions eat people. As

\footnote{As mentioned above, in order to build the partition properly the relevant description should be explicit enough to avoid overlap. Thus, we should have \{LIONS THAT EAT ONLY PEOPLE, LIONS THAT EAT ONLY ZEBRAS, \ldots \}.}
with ordinary kind predication, there might be a number of reasons to refer to a kind. Thus, the traits of the lions that you like in (46a) need not be determined by the relative clause. For instance, it could be that lions that eat people have a number of associated characteristics (e.g. they are faster, smarter, etc.) that you like, despite the fact that you are not fond of their habit to eat people. In such case, (46a) is true and felicitous, as captured by (46b).

6. Conclusions

The merits of looking at English so-called ARs as a species of kind-referring relative clauses are various. All the properties of amount interpretations of relative clauses discussed in sections §2 through §3 follow without additional stipulations, namely, (i) it accounts for the $\text{AMOUNT} \subseteq \text{KIND}$ generalization in (4) above, which states that amount interpretations of relative clauses are parasitic on kind interpretations and (ii) it explains why amount interpretations are not subject to the typical restrictions that we observe with constructions that involve degree-abstraction and degree-operators. Thus, if the results reported here are on the right track, the relative clauses discussed in this paper are not "Amount Relatives", literally speaking, but ad hoc kind-referring expressions.

References


Underspecified changes: a dynamic, probabilistic frame theory for verbs

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Abstract. The verb ‘rise’ can be used both with property-denoting nouns like ‘temperature’ but also with NPs like ‘a Titan’ or ‘China’. Whereas in the former case the change triggered by a rising event is directly related to the subject (its current value increases), this does not hold for ‘a titan’ or ‘China’. In this case it is a property of these objects, say their height or their political power, which increases in value. Furthermore, ‘rise’ does not target a particular property as the examples above show. This data has led Cooper (2010) to the conclusion that it is presumably not possible (i) “to extract a single general meaning of words which covers all the particular meanings of the word in context”, and (ii) “to determine once and for all the set of particular contextually determined meanings of a word”. In this article we present a solution to the two problems raised by ‘rise’ in a frame theory. ‘Rise’ is analyzed as a scalar verb which does not lexicalize a complete scale in its meaning. Rather, it shows underspecification relative to the dimension (property) parameter of a scale. The set of admissible properties is determined by a constraint on the value ranges of properties. If the property is not uniquely determined by the subject, the comprehender uses probabilistic reasoning based on world knowledge and discourse information to defeasibly infer the most likely candidates from this set (2nd problem). The first problem is solved not by simply introducing objects into the representation of a discourse but instead by pairs consisting of an object and an associated frame component which collects the object information contributed by the discourse. Changes triggered by events like the one denoted by ‘rise’ are modelled as update operations on the frame component while the object component is left unchanged.

Keywords: lexical semantics, scalar changes, frame theory, probabilities.

1. Two puzzles about ‘rise’

According to Cooper (2010), the question ‘What is the meaning of an item?’ is divided into the following two subquestions: (i) “is it possible to extract a single general meaning of words which covers all the particular meanings of the word in context?”, and (ii) “is it possible to determine once and for all the set of particular contextually determined meanings?” For Cooper, data like that in (1) shows that the answer to both questions is most likely ‘no’. (Examples (1c) - (1e) taken from Cooper 2010.)

(1) a. The temperature (of the liquid) is rising.
   b. The price (of the commodity) is rising.
   c. As they get to deck, they see the Inquisitor, calling out to a Titan in the seas. The giant Titan rises through the waves, shrieking at the Inquisitor.
   d. Mastercard rises.
   e. China rises.

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In order to arrive at a single general meaning for ‘rise’, it is necessary to characterize the contribution of the subject argument in a unique way. However, the data in (1) shows most likely that this cannot be done. In (1a) and (1b) the change expressed by ‘rise’ is directly related to the denotation of the subject argument. It is the value of the temperature/price that increases. This does not hold for the remaining three examples. The referent of ‘titan’, ‘Mastercard’ and ‘China’ must be held constant. What changes, rather, is the value of a property of the subject referent. For example, in (1c) it is the height of the titan that increases. Hence, there are conflicting constraints imposed by the subjects in (1a) and (1b) on the one hand and the other three examples on the other hand. Even if one focuses on the property that gets changed, there is no uniformity because different properties such as temperature, price and height are involved in these examples. Cooper concludes: ‘This makes it difficult to see how we could give a single type which is general enough to include both varieties and still be specific enough to characterize the meaning of rise’ (Cooper, 2010).

The ‘Mastercard’ and ‘China’ examples are taken by Cooper as evidence that the second question has to be answered in the negative too. Cooper comments: “While speakers of English can get an idea of the content of the examples in (1d) and (1e) when stripped from their context, they can only guess at what the exact content might be. It feels like a pretty creative process” (Cooper, 2010). The problem stems from the fact that given an object like ‘China’ or ‘Mastercard’ there are in general many properties that can be targeted by ‘rise’. What is required, therefore, is an explicit context like the one given by Cooper for ‘China rises’ in which particular properties are singled out:

(2) “The rise of China will undoubtedly be one of the great dramas of the twenty-first century. China’s extraordinary economic growth and active diplomacy are already transforming East Asia, and future decades will see even greater increases in Chinese power and influence. But exactly how this drama will play out is an open question. Will China overthrow the existing order or become a part of it? And what, if anything, can the United States do to maintain its position as China rises?”

Cooper’s argument can be summarized in the following way: (i) ‘rise’ semantically targets a property whose value is increased by an event of this sort; (ii) this property is not uniquely determined; (iii) there seems to be no principled way to characterize or define the set of admissible properties once and for all so that for any given context one element of this set is selected by ‘rise’ (second problem); and (iv) the subject argument of ‘rise’ either denotes the targeted property or an entity which has this property. In the latter but not in the former case, the denotation of the subject argument is held constant (first problem).

In this article we will propose a solution to these two puzzles in a frame theory. In contrast to Cooper’s variant of such a theory which is based on records we apply a variant of frame theory outlined in (Petersen, 2007) and elaborated on for dynamic frames in Naumann (2013) and Gamerschlag et al. (2014). We incorporate insights from two research traditions: (i) ‘temperature’ and ‘price’ are (basically) functional nouns, i.e. they semantically relate a property with an object that has this property and a value of this property. This semantic representation closely resembles the frame representation of nouns in general in terms of typed attribute value
structures. Hence, in our frame theory, all nouns are represented in terms of frames. Furthermore, discourse objects are pairs consisting of an object and an associated frame component. Changes, and more generally updates, are always executed on the frame component while the object component is held constant. This is the key to the solution of the first puzzle. (ii) The key observation for a solution of the second puzzle comes from the notion of a scale. Each admissible attribute is associated with a particular scale which specifies a dimension, a set of values, and an ordering relation on them. ‘Rise’ shows attribute-underspecification: no particular dimension is specified. Rather, it imposes a constraint on the ordering relation defined for the attribute values. Only those properties (dimensions) are admissible which satisfy this constraint.

Before presenting our analysis of ‘rise’, we will first introduce some theoretical prerequisites in the following sections which deal with functional concepts, scalar changes and their relation to frames.

2. Inherently functional nouns with particular value ranges

One way of analyzing nouns like ‘temperature’ and ‘price’ is as being basically inherently functional, i.e. as denoting a functional concept, cf. Löbner (2011). For example, the temperature is always the temperature of something else. Possible objects are persons (Bill’s temperature), bodies (the temperature of the sphere) and three-dimensional spatial regions (the ambient temperature). Similar observations apply to ‘price’. The two objects targeted by such nouns are linked in a particular way. The object denoted by ‘the N’ in an identity statement like ‘The temperature is 90 degrees Celsius’ or ‘The price is 30 Euro’ is the value of a property of the object left implicit in those statements. Making the relation explicit yields for example ‘The ambient temperature is 90 degrees Celsius’. Here, the noun denotes the property itself, e.g. ‘temperature’. Let us call the value of the property the ‘dependent object’ and the object the value is related to by the property the ‘independent object’. For example for ‘The temperature of the liquid is 90 degrees Celsius’, one gets: temperature = property, 90 = dependent value and the liquid = independent object. Two properties of functional nouns like ‘temperature’ and ‘price’ are (i) they are time-dependent and (ii) for a given independent object and time point there is a unique value, i.e. dependent value. Examples of inherently functional nouns that are also time-dependent and (almost) functional are ‘president’ and ‘husband’. The difference between ‘temperature’ and ‘price’ on the one hand and ‘president’ and ‘husband’ on the other lies in properties of the set of (dependent) values. Whereas for the former this set is linearly ordered (100 degrees Celsius is greater than 50 degrees Celsius) there is no ordering on the set of possible presidents or the set of possible husbands. This difference shows up in the admissibility of ‘rise’.

(3) a. The temperature is rising/changing.
b. The president is *rising/changing.

The distinction between dependent and independent objects is directly related to one of the
problems discussed in the first section. The subject of ‘rise’ denotes either a property of an object the value of which is changed by an event of rising or the object the value of a property of which is changed by a rising event. Hence, if the subject does not denote a property, it denotes an entity a property of which is targeted by ‘rise’. The task, therefore, is to find a representation of nouns in which they are not simply interpreted as sets of objects or as sets of pairs of objects but in which also their properties become available.

3. Scalar changes and scalar underspecification

Rappaport Hovav and Levin (2010) make a basic distinction in the verbal domain between result verbs and manner verbs. Examples of both types of verbs are given in (4).

(4) result verbs: clean, cover, empty, fill, freeze, kill, melt, open, arrive, die, enter, . . .  
manner verbs: nibble, rub, scribble, sweep, flutter, laugh, run, swim, . . .

These two classes of verbs differ with regard to what they lexically encode as part of their meaning. Result verbs encode scalar changes whereas manner verbs encode non-scalar changes. According to Rappaport Hovav and Levin (2010: p.8), a scalar change in an entity involves a change in value of a particular dimension for this entity in a particular direction along the scale, with the direction specified by the ordering relation. Hence, scalar changes are changes in the value of a single property or attribute of an entity. By contrast, non-scalar changes cannot be characterized in terms of an ordered set of values of a single attribute (Rappaport Hovav and Levin, 2010: p.12). Rather, they involve complex changes—that is, a combination of multiple changes—and this complexity means that there is no single, privileged scale of change (Rappaport Hovav and Levin, 2010: p.12). Scalar changes are based on the notion of a scale, “where a scale is a set of degrees—points or intervals indicating measurement values—on a particular dimension (e.g., height, temperature, cost), with an associated ordering relation” and “verbs denoting events of scalar change lexically specify a scale”, (Rappaport Hovav and Levin, 2010: p.8). According to Kennedy and McNally (2005), a possible definition of this notion is: a scale is a triple \( \langle S, \Delta, R \rangle \) s.t. \( S \) is a set of degrees, \( \Delta \) is the dimension of measurement and \( R \) is an ordering on \( S \). Thus, following Rappaport Hovav and Levin (2010) different scalar verbs encode different scales, some of them only differing by the order of degree-points. By way of example, consider the two verbs ‘cool’ and ‘warm’, which lexicalize a property scale. For both verbs, the dimension of measurement is that of the temperature of an entity and the values are therefore temperature degrees. They differ w.r.t. to the direction along the temperature scale. Whereas for ‘warm’ there is a change from a smaller to a greater temperature degree (increase in temperature) for ‘cool’, this direction is reversed: the temperature decreases.

Rappaport Hovav and Levin (2010) argue that change of state verbs always lexicalize a complete scale in the sense that all three parameters are specified in the lexicon. If a verb does not lexicalize a complete scale, it does not encode a scalar change according to the authors. For example, Rappaport Hovav and Levin (2010) do not classify ‘cross’ and ‘traverse’ as verbs encoding a scalar change. Though these verbs lexically specify a dimension of measurement (a path) and, therefore, a set of values (position on the path), the direction of motion along this path is not lexically specified and, hence, they do not impose an ordering on the points of the
The view that scalar changes require a complete scale as part of their lexical meaning has been challenged in Fleischhauer and Gamerschlag (2014), who show that change of state verbs coming with a property scale do not necessarily encode a complete scale but can also exhibit scalar underspecification. For instance, none of the verbs in (5) specifies any particular dimension in its lexical meaning that is targeted and depends upon the functional noun realized in subject position to introduce a dimension such as temperature, price and pressure. The verbs ‘rise’ and ‘fall’ in the first two examples operate on the scale provided by the subject and express the ‘direction of change’, i.e. whether the change results in an increase or decrease of values. The verb ‘change’ in the third example is even less specific since it refers to a change along the dimension expressed by the subject without encoding a fixed direction of change.

(5) a. The temperature/price/pressure is rising. → increase in temperature/price/pressure (>)
   b. The temperature/price/pressure is falling. → decrease in temperature/price/pressure (<)
   c. The temperature/price/pressure is changing. → increase or decrease in temperature/price/pressure (>) ∪ (<)

In spite of being incomplete in regard to the dimension, all of the three verbs in the example above can be characterized as change of state verbs since they already address some aspect of change, namely its direction or the fact that a change takes place at all. As will be shown in the next section, this kind of scalar underspecification is the key to our solution of the second puzzle, i.e. the question how the context determines the meaning of a lexical item.

4. (Scalar) changes in a frame theory

Frame theory is based on the notion of an attribute. Attributes are interpreted as functional binary relations. In addition to being functional they are typed (or sorted). For each attribute, there is a source sort and a target sort. For example the attribute COLOR has the source sort physical object and the target sort color. For TEMPERATURE, the source sort is physical object too but the target sort is temperature. A sort s is interpreted as a subset $D_s$ of the global domain $D$. If $s$ is the target sort of an attribute, $D_s$ will be called the value range of this attribute. One way of classifying attributes is in terms of instances (or subtypes) of more general relations. Löbner (2014) distinguishes four classes: (i) mereological attributes (HEAD, HANDLE), (ii) role/correlate attributes (PRESIDENT, SPOUSE), (iii) property attributes (WEIGHT, TASTE) and (iv) event-related/affordance attributes (PURPOSE). The value ranges of attributes can be classified according to their ordering properties. A basic distinction is that between ‘unordered’, denoted by ⊥, and ‘ordered’, <. If the set is ordered, relevant properties are ‘linear’ ($<=$linear$)$, ‘existence of a minimal element’ ($<=$min$) and ‘existence of a maximal element’ ($<=$max$). An attribute dimension is a triple $\langle \Delta_{\text{ATTR}}, D_s, ord \rangle$ s.t. $\Delta_{\text{ATTR}}$ is the interpretation of ATTR, $D_s$ is the value range of ATTR and ord is the ordering defined on this value range. In the present context ord is always at least linear. However, particular verbs can impose stronger conditions, e.g. that the linear order has a minimal but no maximal element. As will be shown below in section 6 this is the case for ‘rise’. Non-stative (or dynamic) verbs operate on the set of attribute dimensions in the frame components of their arguments. They (possibly) im-
Table 1: Classification of change of state verbs

<table>
<thead>
<tr>
<th>verb</th>
<th>unique attribute specified</th>
<th>linear order required</th>
<th>direction of change</th>
</tr>
</thead>
<tbody>
<tr>
<td>cool, widen</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>rise</td>
<td>-</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>cross</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>rename</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>change</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>??</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>non existent</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>non existent</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

Pose constraints on the following three parameters: (i) a particular attribute is specified (yes: + / no: -); (ii) ‘ord’ is required to be (at least) linear (yes: + / no: -) and (iii) a direction of change is specified or not (yes: + / no:-). Table 1 shows the eight possible combinations of these three parameters. The direction of change \( \vec{R} \) is defined in terms of \( ord \): if \( ord = \perp \), \( \vec{R} = \perp \) and if \( ord = <_{linear}, \vec{R} \in \{ <_{linear}, >_{linear}, >\} \). Here, we use the following notation: (i) \( \leq := \cup id \); (ii) \( > := \leq \) and (iii) \( > := \cup < \).

A verb expresses a scalar change if the value range is required to be linearly ordered and the direction of change \( \vec{R} \) is either increasing or decreasing. In contrast to Rappaport Hovav and Levin (2010), we neither claim that a verb specifying a scalar change necessarily determines the attribute dimension nor that the direction of change is always fixed; thus our approach is in line with the definition of a scalar change in Fleischhauer and Gamerschlag (2014). If a verb does not require \( D_s \) to be ordered though it is compatible with such an ordering, we set \( \vec{R} \) to ‘-’. Hence, if \( ord = <_{linear}, a ‘-’ amounts to \( \vec{R} = >_{linear} \). This explains the compatibility of ‘change’ both with ordered and unordered value ranges, witness the examples in (6).

(6) 
   a. The temperature is changing. (\( \vec{R} = >_{linear} \))
   b. The colour of the leaf is changing. (\( \vec{R} = \perp \))
   c. The president is changing. (\( \vec{R} = \perp \))

Table 1 excludes combinations requiring no linear order on the value range while at the same time entailing a direction of change because the direction of change \( \vec{R} \) is defined in terms of the ordering on the value range. Note that the combination ‘unique attribute specified= -’, ‘linear order required= +’ and ‘direction of change= -’ is marked by question marks in the table above since we leave it as an open question whether this particular combination is attested for a verb or not. Possible candidates might be ‘level off’ and ‘reach’ as in ‘Inflation leveled off’ and ‘The temperature reached 30 degrees Celsius’.

5. Attribute-underspecification

From the three constraints on parameters in Table 1, the first two are directly related to properties of an argument that is targeted by a verb. It is only the constraint on the direction of change
that is partly independent of properties of the target argument. Furthermore, if a verb lexically specifies a particular property attribute, the ordering relation is determined too because it is a property of the attribute’s value range which is given by the target sort of the attribute. By contrast, imposing a constraint on the ordering does not uniquely determine a particular property attribute because different such attributes can have ordering relations on the value range with the same properties. This yields attribute-underspecification. Therefore there is an asymmetry depending on whether a unique attribute is determined or whether the properties of the ordering on the value range are specified. In the first case no further underspecification results whereas in the second case one gets attribute underspecification. However, attribute underspecification does not mean that the set of admissible (property) attributes cannot be determined once and for all. It is the set of all property attributes satisfying the constraint imposed by the ordering that are defined for the frame component of the argument targeted by the verb. If the attribute is not specified in the lexicon, it can be (uniquely) determined by the sort of the argument which is targeted by the verb. For example for ‘rise’, the attribute-underspecification is eliminated if the subject argument denotes an attribute whose value range is linearly ordered. This holds for ‘temperature’ and ‘price’. If the subject argument is not an attribute-denoting noun, the underspecification is in general not eliminated because the object denoted by the subject will in general have more than one (property) attribute which satisfies the condition on its value range.

The relation between scalar changes in our frame theory and the notion of a scale defined above in section 3 is the following. The measurement dimension \( \Delta \) corresponds to a single attribute (e.g., \textsc{size}, \textsc{prize}, \textsc{temperature}). The set \( S \) is the value range of the attribute \( D_s \), if it is specified in the lexicon. Since the parameter \( \vec{R} \) is determined by the verb, there is no difference w.r.t. this parameter. The notion of an attribute is, however, more general than that of a dimension in a scale. Attributes can be used to represent arbitrary properties of objects, witness the examples above of various classes of attributes. Attributes that correspond to dimensions are property attributes with a value range that is at least linearly ordered.

6. The constraint on the value range imposed by ‘rise’

In our frame theory verbs can impose constraints both on an attribute and the value ranges of attributes. ‘Rise’ is an example of a verb which imposes a constraint on the value range but does not specify any particular attribute in the lexicon. Hence, attribute-underspecification applies to it. The constraint on the value range is given below in (7).

\begin{align}
\text{(7) } & \quad \text{a. The ordering } < \text{ is linear.} \\
& \quad \text{b. } < \text{ has a minimal element: } \exists \delta, \forall \delta': \delta \leq \delta'. \\
& \quad \text{c. } < \text{ has no maximal element: } \forall \delta, \exists \delta': \delta < \delta':
\end{align}

Hence, the ordering is bounded to the left but unbounded to the right. The third constraint is

\footnote{Remember the dependency between the parameters ‘direction of change’ and ‘linear order required’: if ‘direction of change = +’, then ‘linear order required = +’.}

\footnote{If the value range of an attribute is scalar, then it is a property attribute. However, it does not hold that if an attribute is a property attribute, then its value range is scalar, witness the example of TASTE.}

\footnote{In addition, verbs can impose a constraint on the source sort or target sort of an attribute.
due to the empirical observation that ‘rise’ by itself does not impose a bound on the change. Rather, a (culminating) value can be arbitrarily fixed by a measure phrase, e.g. ‘rise (by) 30m’. Examples of (property) attributes which satisfy this constraint include TEMPERATURE, PRICE, ECONOMIC_POWER and POLITICAL_POWER. Which attributes satisfy this constraint for objects of a given sort depends on the set of attributes defined for the frames of that sort. For example, of the above four examples only ECONOMIC_POWER and POLITICAL_POWER are defined for frames of sort country. We are now ready to define the lexical constraint imposed by ‘rise’.

\[(8)\] ‘rise’ lexically imposes the following two constraints: (i) the subject argument has at least one attribute which satisfies the constraint on the value range given in (7) and (ii) for at least one of those attributes there is an increase relative to the value of this attribute triggered by the rising.

Though ‘rise’ does not single out a unique attribute, a unique set of attributes is determined, namely all those attributes whose value ranges satisfy (7). Hence, instead of specifying a set of admissible attributes in terms of one property that is common to all of them, the set of admissible attributes is determined by one property of their value ranges. This is our answer to the second puzzle of how the context determines word meaning. Before turning to our answer to the first puzzle of how to arrive at a generalized meaning representation of a lexical item, we need to introduce some more details of our frame theory.

7. Modelling world knowledge and discourse information

7.1. Modelling world knowledge

Our frame theory is based on models \( \mathcal{M} = (W, D_o, D_f, D_t, P, R, I) \) s.t. (i) \( W \) is a finite set of worlds which are used to represent epistemic uncertainty; (ii) the domain \( D_o = \bigcup_{\sigma \in \Sigma} D_{\sigma} \) is the union of finite domains \( D_{\sigma} \) based on a partially ordered sort hierarchy \( (\Sigma, \sqsubseteq) \) with basic sorts like ‘event’ (e) or ‘individual’ (d); (iii) \( D_f \) is the domain of frames. Each frame is of a sort \( \sigma \) and is related to a particular world \( w \) by a function \( \text{IN} : \text{IN}(f) \) is the world relative to which \( f \) contains information about its root (details below); (iv) \( D_t \) is a linearly ordered set of time points; (v) \( P \) is a probability distribution on subsets of \( W \). One has \( P(\{w\}) > 0 \) for all \( w \in W \); (vi) \( R \) is an accessibility relation on \( W \) which is assumed to be the universal relation, i.e. \( R = W \times W \); and (vii) \( I \) is an interpretation function.

In our frame theory a distinction is made between objects, i.e. individuals and events, on the one side and frames on the other side. Both are atomic entities that are elements of two separate domains \( D_o \) and \( D_f \), respectively. Relative to a possible world and a time point each object is assigned a set of frames which is partially ordered based on the information contained in a frame belonging to this set. In a discourse, an object is associated with a frame that collects sortal and relational information about it got in the discourse (see below for details). Objects

\[6\]Note that we are aware of the fact that the exclusion of TEMPERATURE in the frame of ‘China’ is an oversimplification since an attribute such as AVERAGE TEMPERATURE IN SUMMER should certainly be part of this frame. However, for the sake of simplicity we exclude TEMPERATURE as an attribute interpreted as the temperature of simple physical objects.
are related to frames by a function \( \text{root} \), which maps a frame to the object which is the referent of the frame in the sense that the information contained in this frame is about this object. Each frame is of a particular sort, say \textbf{person} or \textbf{temperature}. Frames with the same root are ordered by a (partial) information ordering. This ordering is defined in terms of a function \( \theta \), which assigns to each frame the set of relations (chains of attributes) plus the corresponding sortal information defined for it. A frame \( f \) about an object \( o \) (i.e. \( \text{root}(f) = o \)) contains more information than a frame \( f' \) with the same root if \( \theta(f') \subseteq \theta(f) \) and \( \forall \pi', [\pi](f')(o)(o') \rightarrow [\pi](f)(o)(o') \) for \( \pi \) a chain of attributes in \( \theta(f') \), i.e. \( f \) contains all information about \( o \) that \( f' \) contains and possibly some more information. Note that, (chains of) attributes are not interpreted as binary relations on \( D_o \), but their interpretation is relativized in two respects. The first is directly linked to the fact that information about an object is always related to a particular frame. This dependency is achieved by interpreting (chains of) attributes as ternary relations on \( D_f \times D_o \times D_o \).\(^7\) For example, \( [\text{ATTR}] \) assigns to a frame \( f \) a binary relation on \( D_o \) s.t. \( [\text{ATTR}](f)(o)(o') \) is true if \( o \) and \( o' \) are related by \( \text{ATTR} \) in \( f \). This way of relativizing the interpretation of expressions is similar to the way information is made world-dependent in two-sorted type theory. However, this move does not account for the fact that information in frames is in general time-dependent. The values of attributes in a frame can be changed by an event (of the appropriate sort) resulting in another frame which reflects this change of value.

There are various ways of how this time-dependency can be modelled. Let \( D_t \) be a domain of time points that is linearly ordered by \(<_t\). One way is to use a special constant \( \text{Hold} \) on \( D_f \times D_t \) s.t. \( \text{Hold}(f, t) \) is true if the information contained in \( f \) is true at \( t \). An alternative is to relativize the interpretations of relational expressions a second time. Instead of having relations on \( D_f \times D_o \times D_o \), one has relations on \( D_t \times D_f \times D_o \times D_o \). For example \( [\text{ATTR}](t) \) assigns to a frame \( f \) a binary relation on \( D_o \) at time point \( t \). The disadvantage of the second alternative is that it makes it more difficult to compare the information contained in two frames with the same root since this information is always time-dependent.

\[7\]

7.2. Possibilities, information states and discourse objects

Besides world knowledge, discourse information has to be modelled as well. A possibility \( p \) is a pair \( (c, w) \). The first component of a possibility is a stack \( c \), i.e. a function from a finite initial segment of \( \mathbb{N} \) to discourse objects, see below and e.g. van Eijck (2007) and Naumann and Petersen (2017) for details. The second component of a possibility is a possible world \( w \). The stack \( c \) is called the \textit{discourse component} and \( w \) the \textit{world component} of the possibility. An information state is a set of possibilities together with a probability distribution \( Pr \) that is derived from \( P \) (see below for details). Modelling information states as sets of possibilities in the way defined above accounts for epistemic uncertainty. Attribute-underspecification gives rise to such uncertainty if no particular attribute is specified, as in the case of ‘China rises’. Each possibility models a possible resolution in the sense that there is (at least) one attribute which satisfies the condition on the value range in (7). For example, for China there is a possibility in which its political power increases and a possibility in which its economic power increases.

\(^7\)In the context of our argument, the sort hierarchy plays a minor role. Thus, in the current paper, we mainly ignore the sortal restrictions expressed by frames. However, in parallel to the relational information expressed by attributes, the sortal restrictions expressed by sorts are interpreted not as unary relations on \( D_o \) but as binary relations on \( D_f \times D_o \).
In standard semantic theories, a domain extension operation (associated with the meaning of indefinites, or more generally, quantified NPs and verbs) introduces a new object, an individual or an event, into the discourse. In our frame theory a domain extension operation is more complex. Instead of an object a pair consisting of an object and an associated frame is introduced. The frame contains the information gathered about the object plus (possibly) information based on world knowledge of a comprehender. Such pairs are called discourse objects. The first projection (component) is called the object component and the second projection the frame component of the discourse object. Getting more information triggers an update operation on the frame component of a discourse object while keeping the object component constant. Two kinds of updating operations have to be distinguished: (i) getting more ‘static’ information about an object, e.g. sortal and/or relational information that is not time-dependent (getting information about a static world), and (ii) getting information that is dynamic in nature, e.g. information about a property the value of which has been changed due to the object having been involved in an event (information about an evolving, changing world). Though this modelling of discourse objects works fine for non-relational nouns like ‘person’ or ‘China’, it is insufficient for functional nouns like ‘temperature’ ‘price’ or ‘president’. Consider e.g. a basic frame for ‘temperature’.

\[ \text{temperature value} \]

\[ \text{physical object} \quad \text{TEMPERATURE} \]

\[ \text{temperature value} \]

Figure 1: ‘temperature’ frame

In the ‘temperature’ frame the central node is not the root of the frame graph. Rather it has an incoming arc labeled TEMPERATURE indicating that the referent of the central node is functionally dependent on the referent of the open argument node. If this argument is filled with something of type physical object, the actual referent of the concept is determined (each physical object has a unique temperature). Thus, the central node is closed because it is determined by the open argument node.\(^8\)

In order to adequately integrate functional nouns in our discourse model, we propose to model the frame component of functional nouns as a pair of frames, one frame representing the dependent object and the other frame for the independent object.\(^9\) For non-relational nouns like ‘person’ or ‘China’, the dependent and the independent frame component are the same. For functional nouns, the value of the function \(\theta\) contains at least one element of the form \(\otimes\text{ATTR}\), i.e. the converse of \(\text{ATTR}\). For example, in the case of ‘temperature’ one has \(\theta(f) = \{\otimes\text{TEMPERATURE}\}\). By contrast, for non-relational (sortal) nouns no such elements exist.\(^{10}\) As a result, a discourse object is a pair \(\langle o, \langle f_d, f_i \rangle \rangle\) consisting of the object component \(o\) and the frame component \(\langle f_d, f_i \rangle\), which in turn consists of the dependent frame \(f_d\) and the independent frame \(f_i\).

---

\(^8\)In our frame graphs, the central node is marked by a double line; argument nodes are open nodes and denoted as rectangles while closed nodes are marked by ellipses. For more information on frame graphs see Petersen (2007) and Petersen and Osswald (2014).

\(^9\)Non-functional nouns like ‘sister’ do not fall into the scope of the present paper; in principle, they are handled similar to functional nouns.

\(^{10}\)For the sake of simplicity, we claim that frame graphs do not contain circles.
8. Representing changes

Since discourse objects are pairs \( \langle o, \langle f_d, f_i \rangle \rangle \), a dynamic verb can operate on all three components, at least theoretically. In our frame theory, a verb always operates on the frame component while the object component is held constant. With respect to the frame component, it is important to distinguish between constraints on a frame component and the actual change effected relative to a frame component. If the verb imposes a constraint, e.g. on the ordering of the value range of an attribute, this constraint has to be satisfied for a sort in the dependent frame and not in the independent frame. This becomes evident if one considers a functional noun like ‘temperature’. If it is the temperature of a person, the person frame will in general have several property attributes whose value ranges satisfy the constraint imposed by ‘rise’. However, this is not what is required. Rather, it is the value range of the temperature attribute that has to satisfy the constraint. By contrast, the change itself is modelled as an update operation on the independent frame component. This becomes again evident if one looks at an example involving ‘temperature’, like ‘John’s temperature is rising’. The dependent object is a (temperature) value (or degree). This values does not change, witness Partee’s famous puzzle: ‘The temperature is rising. The temperature is 90. \# 90 is rising’. What is changing (evolution of the world, ontic change) is John’s temperature. Its value is higher at the end of the rising compared to its value at the beginning of the event. Hence, the relation between the components of a discourse object and the change expressed by a dynamic verb is as follows.

\[
\begin{align*}
\text{(9)} & \quad \text{The object component, e.g. a temperature value or China, remains constant.} \\
& \quad \text{Any constraints must be satisfied in the dependent frame component.} \\
& \quad \text{The change is defined as an update operation on the independent frame component.}
\end{align*}
\]

Since for non-relational nouns like ‘China’ the two frame components are the same, the constraints and the change are both related to this frame. We are now ready to formulate our solution to the first puzzle: (i) changes are uniformly represented at the level of frames, and (ii) the objects themselves are held constant. (i) and (ii) apply to all arguments, in particular to relational (functional) and non-relational nouns, alike.

9. Static and dynamic frames

A basic frame for ‘rise’ has a single attribute \textit{THEME}. At this level the rising event, i.e. the value of \textit{root} (\textit{frise}), is taken as an atom. By a zooming operation \textit{Z} in the sense of Blackburn and deRijke (1997) this atomic event is decomposed into single step subevents. This level is called the ‘event decomposition’ level (ED). It represents the temporal structure of the event and links it to the level of the described situation, the participating objects, and their roles in the event. Each temporally extended event \( e \) on the ED level is bounded by two boundary events \( \alpha(e) \) (left boundary) and \( \beta(e) \) (right boundary) whose runtimes are singletons (cf. Pinon, 1997). Non-boundary events are linked to global properties of the event, termed ‘static event frames’ (SEF) in Naumann (2013). The basic frame for ‘rise’ described above is of this sort. Boundary events are linked to situation frames (SF) which are built up from the frames for the objects involved. The SFs specify the relevant information about the attribute involved in the change, e.g. \textit{HEIGHT} or \textit{TEMPERATURE}. Let us illustrate this with ‘The balloon rises by 30m’.

Underspecified changes 191
At the top the basic SEF for ‘rise’ with the single THEM relevance-attribute is shown. The ED-level is shown below. Formally, it is achieved by a zooming operation of type ‘temporalization’ (T). At this level the rising event is decomposed into a sequence $e_1 \ldots e_n$ of atomic rising events whose sum is just the rising event which is the root of the rising frame. Each $e_i$ is bounded by two boundary events, represented by the black bullets. As said above, each boundary event is related to a particular time point. The SF at the timepoint of each boundary event gives the information about the attribute whose value gets changed. In this case it is the value of the chain POSITION $\circ$ HEIGHT in the frame of the balloon. The SF level in the figure provides snapshots of the balloon’s height at different time points of the event. A condensed representation in a single frame is given below. Note that ‘trace’ and ‘change’ are “dynamic attributes” which are projected into this frame from the event decomposition frame introduced above. Attributes of this type have the function to record the value change of attributes such as POSITION and HEIGHT over the course of the event (for details see Gamerschlag et al., 2014).
10. The dynamic meaning of ‘rise’

The interpretation of ‘rise’ triggers both a domain extension operation and an update operation. First, an event of rising is introduced into the discourse. Second, the domain object related to the theme argument, e.g. ‘China’, is updated. This update operation is related to the change triggered by a rising event. For scalar verbs in general, the change is effected relative to an attribute of some argument (as discussed in section 4). If the verb shows attribute-underspecification, no particular attribute is singled out. In this case the current information state must be updated for each attribute that satisfies the constraint imposed by ‘rise’ on the value range. This has the effect that for a possibility \( p_i \) in the input, there can be more than one successor possibility in the output. In particular, one has: for each possibility \( p_i \) in the input there are up to \( n \) successor \( \pi_2(c) \) in the output, for \( n \) the number of admissible attributes. Each successor \( \pi_2(c) \) models a change w.r.t. to an admissible attribute and therefore is a possible resolution of the attribute underspecification. The qualification ‘up to’ refers to the fact that a possibility is discarded if in its world component the rising event in the possibility does not bring about a change w.r.t. the attribute specified in the possibility. Hence, this update operation combines aspects of both a ‘normal’ update (information is added to the frame component of a discourse object already on the stack) and a domain expansion operation: it leads to ‘branching’ in the sense that a possibility in the input information state can have more than one successor. In (10) the definition of successor is given and in (11) the (simplified) interpretation of an attribute and two domain extension operations are supplied.

(10) a. A stack \( c' \) is a successor of a stack \( c, c \preceq c' \), iff \( c' = c \ominus \alpha \), for some discourse object \( \alpha \).
   b. A possibility \( p' = \langle c', w' \rangle \) is an object-successor of possibility \( p = \langle c, w \rangle, p \preceq_0 p' \),
      iff \( c' \preceq c \) and \( w = w' \).
   c. A possibility \( p' = \langle c', w' \rangle \) is a frame-successor of possibility \( p = \langle c, w \rangle \) w.r.t.
      position \( v_i \) and value range restriction \( vr \), \( p \preceq_{v_i,vr} p' \), iff \( w = w' \), \( |c| = |c'| \),
      \( \exists o \ f_o f'_o \text{ATTR.} \ c[i] = \langle o, f_o \rangle \land c'[i] = \langle o, f'_o \rangle, f_o \sqsubseteq f'_o, \theta(f'_o) = \theta(f_o) \cup \{\text{ATTR}\}, \]
      \[ \langle vr \rangle(\text{range(ATTR)}) \text{ and } \forall j. (0 \leq j < |c| \land j \neq i \rightarrow c[j] = c'[j]) \].

(11) a. \( s[\text{ATTR}(f)] = \{ p \in s \mid \exists i, j \in \mathbb{N} : p = \langle c, w \rangle, \pi^2(c[i]) = f, \text{IN}(\pi^2(c[i])) = w, \]
      \( \langle \pi^2(c[i]), \pi^1(c[i]), \pi^1(c[j]) \rangle \in \{\text{ATTR}\} \} \)
   b. \( s[\exists] = \{ p' \mid p \in s \land p \preceq_0 p' \} \).
   c. \( s[\text{update}(v_i, vr)] = \{ p' \mid p \preceq_{v_i,vr} p' \land p \in s \} \).

In (10a), stack \( c' \) is a successor of \( c (c \preceq c') \) if it extends \( c \) by a discourse object. In (10b), a possibility \( p' \) is an object-successor of \( p \) if its stack component is a successor of that of \( p \) and the world components are the same. In (10c), a frame-successor \( p' \) of a possibility \( p \) has the same world component as \( p \) and its discourse component (stack) extends the frame component of the discourse object at position \( v_i \) by an attribute \text{ATTR} that satisfies the value range restriction \( vr \) while leaving all other discourse objects the same. (11) specifies an information state \( s \) after update with some information \( \phi \). Here, \( s[\phi] \) stands for the updated information state. In (11a) \( \pi^k \) is the \( k \)-th projection function. \( \pi^1(c[i]) \) is the object stored at position \( i \) and \( \pi^2(c[i]) \) its associated frame, i.e. \( \pi^1(c[i]) \) is the root of \( \pi^2(c[i]) \). The interpretation of an attribute tests
whether the attribute holds between the frame stored at position $i$, the object stored at the same position $i$, and the object stored at position $j$. This operation eliminates possibilities from the information state that do not pass the attribute test. In (11b), $\exists$ non-deterministically extends each possibility in the input by a discourse object. This operation is used, whenever a new indefinite discourse object is introduced. In (11c), $\text{update}(v_i, vr)$ expands an information state by adding to the frame component at position $i$ of the discourse component (non-deterministically) an admissible attribute whose value range satisfies the constraint $vr$.

11. Probabilities: a worked-out example

The set of attributes satisfying the constraint on the value range in (7) imposed by ‘rise’ can be quite large. There are two kinds of information by which this set can be constrained: (i) world knowledge of a comprehender and (ii) the preceding or ensuing linguistic context. For example, a comprehender may have knowledge about China’s rising economic power so that he expects the sentence ‘China rises’ to be about this rising economic power. Context adds extra information to frames in form of an update operation on an input frame. For example, the context below, adapted from Cooper (2010), adds the new information to the ‘China’-frame that the value of the attribute $\text{DIPLOMATIC\_ACTIVITY}$ is ‘high’. This information can be taken as an indication that ‘China rises’ is about its political power and not about its economic power.

(12) China’s rising will undoubtedly be one of the great dramas of the twenty-first century. China’s extraordinary active diplomacy is already transforming East Asia.

In contrast to attributes like $\text{TEMPERATURE}$ and $\text{PRICE}$ which are excluded for ‘China’, the above two kinds of information do in general not exclude all other choices. For example, even if a comprehender knows that China’s economic power rises and he therefore expects the sentence to be about that attribute, encountering later on the information about the high diplomatic activity may well have the effect that he revises his decision to interpret the sentence as being about China’s political power. The information a comprehender has about attributes like $\text{TEMPERATURE}$ and $\text{PRICE}$, namely that they are excluded for objects of sort $\text{country}$, is ‘hard’ information, whereas the kind of information used about the other two attributes above is ‘soft’ information because it can be revised. We will model soft information in terms of probabilities.\textsuperscript{11}

In the rest of this section we will provide a worked-out example which shows how the choice of an attribute can be constrained using a probability distribution which is based on the knowledge of a comprehender who is processing the text in (12).

We begin by defining the probability distribution $Pr_s$ on an information state $s$. Four cases have to be distinguished: (a) an information state with no discourse information (base case), (b) eliminative update, (c) domain extension and (d) expansive update. For cases (b), (c) and (d), $Pr_s$ needs to be updated. The definitions are given in (13), see also Djalali and Kaufmann (2009) by whom these definitions are inspired.

\textsuperscript{11}Hard information is then the limiting case where the probability is either 1 (bottom-up information) or 0 (information like $\text{TEMPERATURE}$, which is not defined for countries).
Underspecified changes

\[(13) \quad \text{a. } Pr_s(\langle \rangle, w) | s) := P(w).
\]
\[\text{b. } Pr_s(p \mid s) := Pr_s(p \mid s)/\Sigma_{p' \in \Theta} Pr_s(p' \mid s), \text{ if } p \in s \mid \emptyset], 0 \text{ otherwise.}
\]
\[\text{c. } Pr_s(p' \mid s[\emptyset]) := Pr_s(p \mid s)/|D|, \text{ for } p \preceq_o p', p \in s, p' \in s[\emptyset].
\]
\[\text{d. } Pr_s(p' \mid s[\text{update}(v_i, vr)]) := Pr_s(p \mid s)/D_{vr} \text{ with } p = \langle c, w \rangle, c[i] = \langle o, f_o \rangle, p \in s, p' \in s[\text{update}(v_i, vr)], p \preceq_v vr p' \text{ and } D_{vr} := \{\text{ATTR} \mid \exists f : f_o \subseteq f \wedge \text{ATTR} \in \Theta(f) \wedge \text{range(ATTR))}\}.
\]

In an information state with no discourse information, the probabilities are those of the world components (see (13a)). For eliminative updates, the probability is shifted by conditioning, i.e. the new probability of a ‘surviving’ possibility from the input is got by dividing its probability in the input by the sum of prior probabilities of all surviving possibilities (see (13b)). For the domain extension operation, the probabilities of possibilities in the input are uniformly distributed over their object-successors (see (13c)), whereas in the case of \text{update}(v_i, vr) they are uniformly distributed over their frame-successors (see (13d)).

For our example, let us make the following simplifying assumptions. For ‘China’, only the attributes \text{POLITICAL\_POWER} and \text{ECONOMIC\_POWER} satisfy the value range constraint imposed by ‘rise’. A discourse object is of the form \langle o, f_o \rangle and not \langle o, (f_0, f_i) \rangle since for China both frame components are the same. The initial information state of the comprehender has two possibilities \(p_1\) and \(p_2\), both containing no discourse information and with worlds \(w_1\) and \(w_2\), respectively. One has \(P(w_1) = 0.5 = P(w_2)\). Applying (13a) yields \(Pr_s(p_1 \mid s) = 0.5 = Pr_s(p_2 \mid s)\). In \(w_1\) there is one rising event with China as theme that increases China’s political power whereas in \(w_2\) there is a corresponding rising event that increases China’s economic power. Processing (12) starts with introducing China at position 0 (positions in a stack are counted beginning with 0) together with a minimal China-frame. The initial probabilities for \(p_1\) and \(p_2\) are not changed, because ‘China’ has singular reference, being a proper name. Processing ‘rising’ (or ‘rises’) introduces a rising event at position 1. Again \(Pr_s\) is not changed since it is assumed that there is one rising event in each world with China as theme.\(^{12}\) In addition, for each rising event the China-frame at position 0 in the corresponding possibility is updated with either the attribute \text{POLITICAL\_POWER} or \text{ECONOMIC\_POWER}. Hence, each of the two possibilities has two frame-successors \(p_{11}\) and \(p_{22}\), yielding an information state \(s’\) with four possibilities. Applying clause (13d), one gets \(Pr_{s'}(p_{11} \mid s') = Pr_{s'}(p_{12} \mid s') = Pr_{s'}(p_{21} \mid s') = Pr_{s'}(p_{22} \mid s') = 0.25\). The probabilities are divided by 2 because there are two attributes satisfying the value constraint. Next it is tested whether a change is effected by the two rising events relative to the two attributes. In \(w_1\) \text{ECONOMIC\_POWER} and in \(w_2\) \text{POLITICAL\_POWER} fail this test. The corresponding possibilities are discarded. For \(Pr_{s'}\) clause (13b) applies, shifting the probabilities of the two remaining possibilities \(p_{11}\) and \(p_{22}\) to 0.5. This is summarized in the table below where we focus on the relevant attributes.

<table>
<thead>
<tr>
<th>World</th>
<th>Attribute</th>
<th>(Pr_s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>(p_{11})</td>
<td>\text{POLITICAL_POWER}</td>
<td>0.5</td>
</tr>
<tr>
<td>(p_{22})</td>
<td>\text{ECONOMIC_POWER}</td>
<td>0.5</td>
</tr>
</tbody>
</table>

Table 2: Distribution after update with ‘China’ and ‘rising’

\(^{12}\)If there are \(n\) objects in the universe, clause (13c) applies first, applying clause (13b) twice, first for the sortal information ‘rise’ and then to the information that China is the theme, yields the same result as stated in the text.
The discourse information the comprehender has about China in this information state is contained in the frame below.

![Figure 4: Frame for ‘China’](image)

⊥ indicates that the comprehender does not know whether a change occurred relative to POLITICAL_POWER or ECONOMIC_POWER. Hence, without further information a comprehender cannot distinguish between the two links marked by ‘?’ in the ‘China’s rising’-frame below, again representing the frame corresponding to all discourse information in the information state.

![Figure 5: ‘China rises’-frame with equal probabilities](image)

In order to account for the contextual information about the attribute DIPLOMATIC_ACTIVITY we have to take the comprehender’s expectation about this attribute into account. The (revised) initial distribution is shown below.

<table>
<thead>
<tr>
<th>attribute</th>
<th>DIPL..ACTIVITY</th>
<th>P(w)</th>
</tr>
</thead>
<tbody>
<tr>
<td>w_{11}</td>
<td>POL..POWER</td>
<td>low</td>
</tr>
<tr>
<td>w_{12}</td>
<td>POL..POWER</td>
<td>high</td>
</tr>
<tr>
<td>w_{21}</td>
<td>ECO..POWER</td>
<td>low</td>
</tr>
<tr>
<td>w_{22}</td>
<td>ECO..POWER</td>
<td>high</td>
</tr>
</tbody>
</table>

Table 3: Initial distribution with DIPLOMATIC_ACTIVITY = high included

Processing ‘China’s extraordinary active diplomacy’ in (12) updates the (global) ‘China’-frame containing the discourse information to that below.
Updating with this ‘hard’ information triggers an update in $Pr_S$ using clause (13b). The new distribution is shown below.

<table>
<thead>
<tr>
<th>attribute</th>
<th>DIPL. ACTIVITY</th>
<th>$Pr_S$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$p_{11}$</td>
<td>POL. POWER</td>
<td>high</td>
</tr>
<tr>
<td>$p_{22}$</td>
<td>ECO. POWER</td>
<td>high</td>
</tr>
</tbody>
</table>

Table 4: ‘China rises’: distribution after update with DIPL. ACTIVITY = high

Hence, using the ‘hard’ information that China’s diplomatic activity is high and the comprehender’s expectations about the relation between this kind of activity and the two different powers, results in a probability distribution in which the two attributes no longer have the same probability. Rather, the comprehender has for POLITICAL POWER a probability of 65.75%. Next, he can apply a decision rule. One of the most simplest ones is ‘Choose that possibility with the highest probability’. Applying this rule leads a comprehender to expect that the rise of China in (12) is most likely to be about an increase in its political power. Even if this rule is applied, a change in economic power is still an option. The ‘rise’-frame resulting after application of the decision rule is shown below.

Thus, if no further information is provided, the comprehender expects that ‘China rises’ in the context of high diplomatic activity means that the polical power of China is rising.

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Coreference and disjoint reference in the semantics of narrative dance

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Abstract. This paper presents an exploratory production study of Bharatanatyam, a figurative (narrative) dance. We investigate the encoding of coreference vs. disjoint reference in this dance and argue that a formal semantics of narrative dance can be modeled in line with Abusch’s (2013, 2014, 2015) semantics of visual narrative (drawing also on Schlenker’s, 2017a, approach to music semantics). A main finding of our investigation is that larger-level group-boundaries (Charnavel, 2016) can be seen as triggers for discontinuity inferences (possibly involving the dynamic shift from one salient entity to another).

Keywords: co-reference, disjoint reference, dance semantics, iconic semantics, picture semantics.

1. Background and motivation

In this paper, we aim to contribute to new lines of research that look at different cognitive systems (in the cognitive science/neuroscience sense; cf. Rebuschat et al., 2011) and how they relate to each other. Our research builds on recent pioneering investigations that explicitly connect language and linguistics to other fields such as music cognition (Schlenker, 2017a) and dance (Charnavel, 2016). A well-known predecessor of such approaches is the work of Lerdahl and Jackendoff (1983), who proposed a generative theory of music. In this paper, the question of interest is whether dance has something akin to a (compositional or non-compositional) “semantics”, which we can describe by means of linguistic tools. We thus adopt the methodological approach of Lerdahl and Jackendoff, applying linguistic methodology to other cognitive systems in order to investigate underlying commonalities.

In exploring the semantics of dance, we directly build on Charnavel’s (2016) question of whether dance has hierarchical structure (which derives from grouping; see also Lerdahl and Jackendoff, 1983). On the semantics side, we proceed to ask what kind of meaning may be encoded in dance. This type of research being foundational, we start by carrying out a production study to establish the range of possible factors that we can investigate. A long-term goal of this investigation is to establish the common semantic properties of (non-)linguistic cognitive systems.

1 We thank the Kala Saadhana Arts & Dance Institute (and, in particular, its founder and artistic director Kavitha Laxmi) for collaborating with us on the dance study. For assistance in preparing the experimental stimuli, carrying out the recordings and post-processing of the motion-capture recordings, we thank Tonje Andersen, Jeanette Birtles, David Buverud, and Sigurd Hanserud. We are grateful to Philippe Schlenker for comments on a draft version of this paper. For useful feedback and discussion, we thank the audiences at the fourMs Forum (Department of Musicology, University of Oslo), the Language and Cognition group (Harvard University), the workshop in honor of David Pesetsky’s 60th birthday (MIT), the CASTL colloquium (University of Tromsø), and at Sinn und Bedeutung 22. The dance study obtained ethical approval from the Norwegian Centre for Research Data (NSD).
1.1. Co-reference and disjoint reference in dance?

Given the broad range of different musical genres and dance forms, linguistic investigations that venture into music or dance can adopt one of the following approaches. They can either try to make generalizations across genres (e.g., Charnavel, 2016; Schlenker, 2017a) or focus on a case study (see Katz and Pesetsky, 2011, who zoom in on Western art music as instantiated by the works of Mozart and Bach). In our study, we choose the second route, focusing on *Bharatanatyam*; a narrative dance form (outlined in section 1.2 of this paper). This allows us to draw on the insights of Abusch (2013, 2014, 2015) with regards to visual narrative. Naturally, a long-term goal of exploring the semantics of dance should include an in-depth investigation of abstract iconic meaning atoms as posited by Schlenker (2017a) for music; these may be manifested in dance through different types of spatiotemporal movement descriptors, e.g. the *quality* of a given movement may be described as “smooth” vs. “jagged” (see for example Guest, 2004, and Napoli and Kraus, 2015, for overviews on the parameters of dance and movement).

Our strategy to approach dance semantics was to single out a phenomenon that we could investigate by means of a production study, namely coreference vs. disjoint reference. The encoding of coreference and disjoint reference between noun phrases is illustrated (very coarsely) in (1) and (2), respectively. Note that we do not aim to contribute to the large body of literature on how exactly such sentences should be analyzed (e.g., Heim, 1982), i.e. we gloss over the difference between truth-conditional and presuppositional content in (1) and (2), and we take (1a) to roughly have the truth conditions in (1b), whereas (2a) roughly has the truth conditions in (2b). The difference between (1) and (2) that is at the center of our exploration is that (1) introduces a single discourse referent whereas (2) introduces two separate discourse referents (see also Kamp and Reyle, 1993).

(1)  \[ \text{coreference} \]
   a.  *A man* came into the room and *that man* closed the window.
   b.  true iff \( \exists x [x \text{ is a man } \& x \text{ came into the room } \& x \text{ closed the window}] \)

(2)  \[ \text{disjoint reference} \]
   a.  *A man* came into the room and *another man* closed the window.
   b.  true iff \( \exists x [x \text{ is a man } \& x \text{ came into the room} \]
   \& \( \exists y [y \text{ is a man } \& y \text{ closed the window } \& y \neq x] \]

As linguists, we are interested both in the meanings of natural language expressions, such as the sentences in (1a) and (2a), and in how they are compositionally derived from their parts. Another relevant question in formal semantics concerns the difference between types of content (i.e., using the terminology of Potts, 2015, the difference between truth-conditional *at-issue* content and non-*at-issue* content, which encompasses presuppositions, conventional implicatures, and conversational implicatures). We will return to this second question later.

Focusing on the coreference/disjoint reference distinction, Abusch (2013) investigates comics without words (French *sourds*), i.e. purely visual narratives. She focuses on mangas such as

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2 We follow the convention in the literature and capitalize the first letter of *Bharatanatyam*. 

Pritty Patel-Grosz et al.
Masashi Tanaka's *Gon*, which tell the story of Gon, a small dinosaur that interacts with real life animals. The question that Abusch raises is as follows: in a comic (Episode 4) that contains a number of eaglets, a reader can establish coreference across panels, i.e. if we see an eaglet depicted in panels 32, 33, 34, and 36, we generally infer that this is the same eaglet (as opposed to one of the others that have been introduced earlier). The central question for Abusch is how coreference across panels is established in such comics, i.e. what is the cognitive mechanism behind such identity inferences. In the absence of words and pointing gestures, Abusch takes this to be a non-trivial question. In line with Discourse Representation Theory (Kamp and Reyle, 1993), she proposes that the referents in comic panels are existentially quantified, (3a-c), and coreference arises from post-semantic identification of discourse referents in the pragmatics (which is a type of pragmatic enrichment), (3d). Such existential quantification is plausible in visual narratives, as there are no definite descriptions comparable to the eaglet in natural language.

(3)  
coreference in comics without words (Abusch 2013)  
   a. panel 34: “[an eaglet]₁ bounced down a cliff face”  
   b. panel 35: “[a bobcat]₂ looked and opened its mouth”  
   c. panel 36: “[a bobcat]₃ jumped toward [an eaglet]₄ that was bouncing down”  
   d. pragmatic enrichment  
      → “[the bobcat]₃=₂ jumped toward [the eaglet]₄=₁ that was bouncing down”

Crucially, the questions and insights that Abusch (2013) addresses for comics without words should carry over to any type of silent visual narratives, including narrative dance and pantomime. This motivates our case study of Bharatanatyam as presented in the remainder of this paper.

When we investigate the semantics of dance, we naturally aim to look for any phenomena that may reflect properties similar to those found in natural language semantics. Coreference vs. disjoint reference is a very basic and fundamental distinction in natural language semantics. As a consequence, if we find that it can be encoded in dance, this can be taken to lend initial support to a view that a semantics of dance may be conceivable.

1.2. Enter Bharatanatyam

*Bharatanatyam* is a classical South Indian dance that originates in Tamil Nadu (see Puri, 1986, 2004; Williams, 2003; Ramesh, 2013, 2014); it is a type of figurative (narrative) dance that typically serves to tell a story. As a figurative dance, it is more similar to language (and silent visual narrative) than other dance forms (such as ballet, contemporary or street dance), yet more conventionalized than pantomime (which can be viewed as an extreme form of figurative dance; see Charnavel, 2016). We thus expect it to share properties of silent visual narratives. Note that, while Bharatanatyam is typically accompanied by music or spoken word (e.g., singing of the narrative), it is not necessarily accompanied by music, and we recorded our stimuli (described in section 2) without music.

Traditionally, Bharatanatyam is used to tell religious narratives, but it also allows for secular and modern stories in contemporary dance productions. As outlined by Puri (1986), the dance
has a rich inventory of conventionalized gestures, including around 31 types of single hand gestures (*hasta mudras*) and 27 types of double hand gestures, which have received some attention in the semiotic literature (see Puri, 1986:271-276; see also Ikegami, 1971). The double hand gestures are combinations of two single hand gestures. Gesture inventories and their sizes vary, depending on the source material, since this is a 2000-year-old danceform. Hand gestures are semantically underspecified; for instance, the *patāka* (‘flag’) gesture, which involves a flat hand with fingers touching (similar to the hand position when ‘high-fiving’) can be interpreted as one of the entities from the following set (Ikegami, 1971:373):

(4) **possible meanings associated with the patāka (‘flag’) mudra** (Ikegami, 1971:373)

‘clouds, a forest, things, bosom, might, peace, a river, heaven, prowess, moonlight, strong, sunlight, wave, entering, silence, an oath, the sea, sword, a palmyra leaf’

This underspecification is resolved by the context, i.e. the eventual meaning of a *patāka* mudra depends on factors such as the position of the arm, the accompanying movement, and so forth.

In addition to hand gestures, Bharatanatyam makes gestural use of the entire body; Puri (1986:251) identifies whole body gestures as “larger action sign units”, which subsume a dancer’s eyes, face, neck, torso, limbs and feet. We can thus differentiate between “local” gestures such as hand-and-arm combinations, and “global” full-body gestures. In our study, we focused on such “global gestures”, since we take hand gestures to have symbolic meanings, which are conventional in the sense that they may be rote learned (requiring a trained audience to correctly interpret them). Global gestures are a phenomenon that we may also expect to find in non-conventionalized spontaneous dance, which is relevant for future studies that build on our findings.³

To move away from low-level symbols such as hand gestures (which may simply have a sign-based semantics), our strategy was to look at more abstract and global types of meaning such as the coreference/disjoint reference distinction. We now proceed with describing the setup of our explanatory production study.

2. **Experimental design**

In our investigation of Bharatanatyam, we are working with Kavitha Laxmi, who is the artistic director of the Kala Saadhana dance institute in Oslo and a professional Bharatanatyam dancer.⁴ For our exploratory production study, we recorded dance sequences based on a set of items that we constructed in order to probe for coreference vs. disjoint reference. We designed our stimuli as short narrative texts. The items were designed in a way that aims to utilize conventional meanings such as the ones associated with hand gestures, illustrated in (4) above (including objects such as ‘palmyra leaf’, cf. (7)). The context for all items is given in (5); this context (an artist having designed a statue for a temple) was based on recent dance productions at the Kala Saadhana dance institute with the aim of limiting artificial components in the narrative that are solely due to the experimental design. What is

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³ Note that facial expressions are also used as part of the Bharatanatyam sign system; given the nature of our study, our dancer aimed to minimize the use of facial expressions and compensate for it with other gestures.

⁴ For illustration, a dance sequence can be found at https://www.youtube.com/watch?v=O-LpIysAKE4
crucial for our setup is the idea that there are several possible referents in the context (here: ‘the room is full of people’); this allows us to freely introduce discourse referents.

(5) **Context:** An artist has designed a statue for a temple. She is at the temple, watching how people interact with the statue; the room is full of people.

We recorded 6 mini-narratives in 2 conditions (coreference vs. disjoint reference), i.e. 12 dance sequences in total. Two sample narratives are given in (6) and (7). This setup allows us to elicit minimal pairs in our production study. In each item, both dance sequences start the same, e.g. in (6a-b), the artist sees a strong man sitting on the ground. Then they differ in terms of whether the same individual is involved in another action, or a different individual. The embedding in perception contexts (‘the artist sees…’) aims at fixing a perspectival center for the narrative; in follow-up studies, we included unembedded variants (e.g. ‘A woman is sitting on the ground. […]’). The resulting dance sequences do not reflect this difference.

(6) **Item 1**
   a. The artist sees a strong man sitting on the ground.  
      Then she sees that *the same man* is holding a spear.  
      (coreference)
   b. The artist sees a strong man sitting on the ground.  
      Then she sees that *another man* is holding a spear.  
      (disjoint reference)

(7) **Item 2**
   a. The artist sees a woman waving a palmyra leaf in the sunlight.  
      Afterwards *that woman* is pointing at the clouds in the sky.  
      (coreference)
   b. The artist sees a woman waving a palmyra leaf in the sunlight.  
      Afterwards *another woman* is pointing at the clouds in the sky.  
      (disj. ref.)

In terms of possible manipulations, Bharatanatyam is relatively flexible. It is typically accompanied by music and chanting, but it can also be danced without them. We recorded our stimuli without music.

The dance sequences were recorded in the Music and Motion Lab of the Department of Musicology, University of Oslo. The professional Bharatanatyam dancer was recorded by one video camera and eight motion capture cameras, using an infrared, marker-based Qualisys motion capture system with eight wall-mounted Oqus 300 cameras, capturing at 200 Hz. A total of 45 reflective markers (“dots” to be tracked by the cameras) were placed on the body of the dancer. The advantages of such a production study is that we can compare minimal pairs and see how intended meanings can be encoded. After recording the 12 dance sequences without any accompaniment, we recorded the same 12 dance sequences while slowly reading out the text; this allowed us to map the recorded movements (and related gestures) to intended meanings in case of uncertainty. The dancer did not choreograph the dance sequences in advance, but read the dance sequences before beginning the dance sequence. While the production thus involves a certain amount of planning (and is not fully spontaneous), it still retains a certain amount of spontaneity.

For the analysis, the recordings were post-processed in the Qualisys Track Manager software (QTM 2.16). This software generates a 3-dimensional (3D) rendering based on the multi-
camera recording of the reflective markers, as illustrated for four dance positions in Figure 1. In the remainder of this paper, we use the 3D renderings in order to focus on the “global” (full-body) gesture aspects of the dance sequence that are relevant for us (glossing over details that may be present in the live video recording yet lost in the 3D rendering).

While we limit the discussion in this paper to a qualitative analysis, the methodology (motion capture) lends itself to quantitative follow-up analyses using numerical methods (see Kelkar and Jensenius, 2018, for an example).

Figure 1: sequence of four dance positions (stills from the video recording and 3D motion capture rendering, with motion history trajectories)

In the next section, we proceed with a qualitative analysis of the results.

3. Qualitative analysis of the results

We start by analyzing the coreference sequence, (6a), adapted in (8); as shown in Figure 2, we can zoom in on the movement and study different parts. In Figure 2, each label [Pₙ] represents a dance position; these positions are stipulated at arbitrary cut-off points, since a dance performance is by its very nature non-discrete. As indicated in (8), we can identify the dance position [P₁₁] with an activity of sitting on the ground, whereas the dance position [P₁₄] represents an activity of holding a spear. Intermediate stages (such as [P₁₂] and [P₁₃]) cannot be as easily connected to parts of the written narrative.

(8) The artist sees a strong man [P₁₁ sitting on the ground]. Then she sees that the same man [P₁₄ is holding a spear].
What Figure 2 shows is that the coreference condition simply involves a fluid motion from displaying a sitting position to displaying a spear-holding position. It does not seem to be necessary (in the given context) to separately mark coreference between the “sitter” and the “spear holder”. By contrast, the disjoint reference condition, repeated in (9) from (6b), has additional complexity, as illustrated in Figure 3. Once again, we can identify a dance position that symbolizes a sitting on the ground activity, [P21]; an attentive reader will notice a remarkable consistency between [P11] in Figure 2 and [P21] in Figure 3, which are taken from two separate recordings. We can also identify a dance position that symbolizes a spear holding activity, [P25]. Most interestingly, for our purposes, the marking of disjoint reference can be broken down into three different dance positions that are assumed between [P21] and [P25]. Step by step, we notice that after giving up the sitting position [P21], the dancer first uses a mudra (here: hand-and-arm gesture) that symbolizes “another/different”, in [P22] (roughly: a round movement of the right hand and arm from the left to the right). She then marks a new position in the visual space, [P23], and she then assumes the new position, [P24]. Eventually, she assumes the spear-holding position in [P25], but does so in a way that mirrors the spear-holding position in the coreferent condition ([P14] in Figure 2), i.e. it is now the left arm that is raised (as opposed to the right arm) and the dancer faces towards the left (as opposed to the right).

(9) The artist sees a strong man [P21 sitting on the ground].
Then she sees that [P22+P23+P24 another man] [P25 is holding a spear].

The marking of a new position on stage (and thus in the visual space), [P23] is a phenomenon that is reminiscent, from a linguist’s perspective, of the loci in sign language (see Schlenker,
2017c, for a recent survey article), opening new lines of inquiry for follow-up studies. Assuming the new position also appears reminiscent of phenomena such as *Action Role Shift* in sign language (see Davidson, 2015, for a recent discussion).

For present purposes, we take the sequence in \([P_{22}]-[P_{24}]\) to be crucial for an understanding of how disjoint reference, in particular, can be encoded in dance. While we have not yet carried out perception studies on the basis of these data, we carried out an informal pilot study in which two of our research assistants (who had not yet seen the dance sequences) watched the dance sequences in random order with the task of determining for each sequence whether it described a story about a single individual or two separate individuals. Even after being informed about the ‘another’-symbolizing mudra, they found this mudra difficult to track. Instead, they reported that the introduction of a new position on stage was a major cue for introducing a second individual, while the absence of such a new position implied the lack of such a second individual. We thus expect this to be a feature of the dance that may carry over into other narrative dance forms, and possibly also into non-narrative dance forms as long as the dancer pursues an intention of narrating a story. Section 4 shows how a semantics of dance could be formally implemented (drawing on Abusch, 2015) and which role *grouping* may play in a dance semantics (drawing on Charnavel, 2016). Section 5 briefly returns to the mirroring that we observed in comparing \([P_{25}]\) in Figure 3 to \([P_{14}]\) in Figure 2.

4. Theoretical interpretation of results

In theoretically interpreting the findings, one factor that is clearly relevant (though it has not previously been connected to semantic interpretation) is the notion of *grouping* (see Lerdahl and Jackendoff, 1983). Charnavel (2016) argues that dance shares hierarchical grouping with language and music, which may be interpreted as giving rise to a syntactic structure of dance.

Building on Lerdahl and Jackendoff (1983), Charnavel (2016:13) posits five *grouping well-formedness rules* three of which are quoted in (10).

10. *grouping well-formedness rules* (Charnavel, 2016:13)
   a. \(GWFR2\): A dance constitutes a group.
   b. \(GWFR3\): A group may contain smaller groups.
   c. \(GWFR5\): If a group \(G_1\) contains a smaller group \(G_2\), then \(G_1\) must be exhaustively partitioned into smaller groups.

By virtue of the grouping well-formedness rules in (10a-c), grouping serves to create hierarchical structure (in the sense of an exhaustive partitioning of a dance sequence into sub-sequences [groups], which may, in turn, be partitioned into further sub-sequences [groups]). What becomes central at this point are the *grouping preference rules* that determine the sub-sequences (or constituents) of a dance sequence. Charnavel (2016) proposes fifteen such grouping preference rules, of which the most relevant (for our purposes) are given in (11).

11. *grouping preference rules* (Charnavel, 2016:18,19,24)
   a. \(GPR1\) (change of direction): Consider a sequence of positions \(p_1, p_2, p_3, p_4, p_5, p_6\). The transition \(p_3-p_4\) may be seen as a group boundary if the path formed by \(p_1-p_2-p_3\) does not have the same direction as the path formed by \(p_4-p_5-p_6\).
In section 6, we lay out the hypothesis that hierarchical grouping in narrative dance can be mapped to situation structure. We can start by asking how grouping may be used to convey disjointness (e.g. disjoint reference when two characters are introduced into a narrative), as specifically instantiated by Bharatanatyam. We propose the informal rule in (12).

\[(12)\] grouping-based coreference (first approximation)

a. In the absence of a group boundary, a dance sequence \([P_n]-[P_{n+1}]\) is interpreted as continuous (e.g. describing a narrative about a single individual).

b. If there is a group boundary between two dance positions \([P_n]\) and \([P_{n+1}]\), then a dance sequence \([P_n]-[P_{n+1}]\) is interpreted as discontinuous (e.g. describing a narrative about two separate individuals).

The workings of grouping-based coreference is illustrated for the disjoint reference condition in Figure 4, where an orientation shift occurs between positions \([P_{23}]\) and \([P_{24}]\). A reader may wish to verify that such an orientation shift does not occur in the coreferent condition, given in Figure 2 above. In terms of Charnavel’s grouping preference rules, \((11)\), it is not completely clear whether the rule at work is GPR1 (change of direction) or GPR2 (change of orientation), as a change of direction seems to be combined with a change of orientation in this sequence; however, it is clear that the change from \([P_{23}]\) to \([P_{24}]\) is quite pronounced, in line with GPR10 (intensification).

Crucially, if we factor in smaller changes in the dance sequence as group-inducing (at a lower level), then we can posit at least a three-level hierarchical structure, as given in (13), using Charnavel’s notation. For the purpose of illustration, we assume that each of the positions in Figure 4 is associated with a low-level group boundary, given that the orientation direction of body parts constantly changes (hand-and-arm in \([P_{21}-P_{22}]\), upper body and arms in \([P_{22}-P_{23}]\), and so forth). The role of global (whole-body) gestures comes into play in connection with
Charnavel’s GPR10, since such gestures are generally more intense than gestures that only involve individual body parts. In line with GPR1 and GPR2, as stated in (11), we position the larger-level group boundary between [P23] and [P24], i.e. in the transition between them (as opposed to identifying it with one of these dance positions).

(13) **structure of the disjoint reference dance sequence**

\[ P_{21} \quad P_{22} \quad P_{23} \quad P_{24} \quad P_{25} \]

\[
\begin{array}{c|c|c|c|c|}
|---|---|---|---| & \text{low-level grouping} \\
|-------------|--|--| & \text{larger-level grouping} \\
|-----------------| & \text{top-level grouping (complete dance)} \\
\end{array}
\]

The core idea here is that group boundaries themselves appear to be meaningful in narrative dance in that they signal *discontinuity*; we expect to find similar effects in other (non-narrative) dance forms.

5. Towards a formal semantic analysis of narrative dance positions

We now take steps towards a formal semantic rendering of the generalizations in section 4. An important first step consists in defining how exactly we should approach the semantics of pictures, i.e. how we could define truth in a visual narrative. In order to answer this question, we build on Abusch (2015), who posits a generalized possible worlds model for informational entities; her idea is that any sentence, picture, etc., counts as an informational entity when it rules out some possibilities, based on the definition in (14).

(14) **possible worlds model of information content** (Abusch 2015:2)

any informational entity such as a sentence or picture rules out some possibilities

\[=\] possible worlds, situations, or scenes] and admits others

Let us illustrate Abusch’s idea for the dance position [P21] in Figure 4. (This example is closely modeled after Abusch’s own example that involves two octahedrons.) Assume, for our purposes, that the world is populated by finitely many undistinguishable persons and nothing else. In such a scenario, if I say “There is a person who is sitting.”, I rule out a range of possible scenarios (in line with (14)), namely ones in which there is no person, or in which the person is not sitting. The statement in (15) is thus understood to provide new information about a given situation that we are describing.

(15) There is a person who is sitting.

Crucially, Abusch argues that a picture achieves exactly the same result. In parallel to (15), the dance position in (16) can be understood to provide new information about a given situation (namely the current point in time in a narrative that is being told). As Abusch observes, when it comes to the question of what a world or situation is like, (16) rules out possibilities in which no sitting activity takes place, while ruling in possibilities in which a sitting activity takes place. The dance position in (16) thus qualifies as an informational entity in line with (14). Abusch is careful to point out that pictures are often more informative than sentences; taken at face value, a naïve observer may infer from (16) that (in addition to being in a sitting position) the person in the narrative has one leg straight and one leg at an angle.
Abusch (2015) proceeds to identify the semantics of a picture with the set of possibilities that it admits. This means that we can define the semantics of a picture in terms of possible worlds, situations, or scenes. Treating any given dance position \([P_n]\) as a picture, we can then posit satisfaction conditions as given in (17).\(^5\) Truth in visual narrative is thus defined in terms of how well a dance position \([P_n]\) maps to a situation/scene \(\sigma_n\) in the narrative; i.e. the dance position in (17) counts as satisfied by a fictional situation \(\sigma\) (i.e. “true” in \(\sigma\)) if a sitting activity is taking place in \(\sigma\).

\[
\text{(17)} \quad \text{satisfaction conditions for dance position that describes a sitting activity}
\]

\begin{align*}
\text{a situation } \sigma \text{ satisfies} & \quad \text{only if in } \sigma \text{ a person is sitting.}
\end{align*}

For now, the rendering in (17) is connected to narrative—or figurative—dance, which encodes a visual narrative. However, as long as we allow for more abstract, iconic atoms of meaning, it should be clear how this view carries over to all dance forms, including non-narrative dance forms. Schlenker (2017a) identifies meaning in music with inferences that can be drawn on a (fictional) virtual source (e.g. an increasing volume may symbolize that a source is gaining in size, and/or moving closer). Combining Schlenker’s source-based semantics with Abusch’s picture semantics, we could thus posit more abstract satisfaction conditions such as (18), which corresponds to \([P_{13}]\) in Figure 2. (One interesting future direction to explore in this respect touches on correlations between pitch and vertical motion in the bodily responses of (untrained) listeners to music, as discussed by Kelkar and Jensenius, 2018.)

\(^5\) Note that this is glossing over the viewpoint-dependence of pictures. As discussed by Abusch (2013, 2015), pictures are generally related to the objects that they depict by means of projection lines that are oriented towards a given viewpoint.
Once we look beyond Bharatanatyam, including non-figurative dance, we may thus need a more iconic semantics in line with Schlenker (2017a). An example of future venues for exploration is given by Kelkar and Jensenius (2018), who outline six ways in which (untrained, i.e., for our purposes, “naïve”) listeners move their two hands to accompany music that they are hearing. From the perspective of Schlenker (2017a), it is plausible that the two hands separately (or jointly) represent virtual sources, which may give rise to meaning inferences on part of an onlooker.

6. Towards a formalization of grouping-based coreference

Having established an approach to “truth” in narrative dance (in line with Abusch 2015), we can now proceed to reviewing the rule of grouping-based coreference that we introduced in section 4. To that end, let us reconsider the coreferent dance sequence from Figure 2, repeated in Figure 5. In line with Abusch (2013:12, 2014:10), we posit the satisfaction conditions in (19) to (partially) describe the dance positions in Figure 5. We will henceforth use the dance position label, [Pₙ] to stand in for the actual dance position. This notation is parallel to the way in which Abusch (2013, 2014) labels the panels in a comic. What becomes explicit from (19) is that dance positions [Pₙ] are mapped to propositions [[Pₙ]].

6 Note that, since dance is continuous, discrete positions such as [P₁₁] and [P₁₂] must be stipulated. For now, we keep treating dance positions as static images, but one open question concerns the continuity (movement) between them.

(19) \begin{align*}
\text{a. } & \text{A situation/scene } \sigma_{11} \text{ satisfies } [P_{11}] \text{ only if in } \sigma_{11} \text{ a person is sitting.} \\
\text{b. } & \text{A situation/scene } \sigma_{14} \text{ satisfies } [P_{14}] \text{ only if in } \sigma_{14} \text{ a person is holding a spear.}
\end{align*}
Based on our findings with regards to coreference vs. disjoint reference, we formalize the grouping-based coreference rule (or grouping-based coreference principle) as given in (20), building on Abusch (2013:13). We illustrate this rule below, though it is worth guiding the reader’s attention to the phrase ‘narratively relevant’ in (20a) and (20b); as of yet, this is a notion that we leave undefined, to be further explored at a later stage. The underlying intuition is that we are only concerned with situations that are delimited and separated by larger-level grouping boundaries in the sense of (13). This is crucial since a complete narrative dance will of course always describe larger situations that contain all dance sequences \([P_n]\) that it contains, i.e. if we were to eliminate ‘narratively relevant’ from (20), the rule would become void.

(20) grouping-based coreference (second approximation)
   a. In the absence of a group boundary, a dance sequence \([P_n]-[P_{n+1}]\) is interpreted as corresponding to a larger narratively relevant situation \(\sigma_{\text{top}}\).
   b. If a narrative dance sequence corresponds to a single narratively relevant situation \(\sigma_{\text{top}}\) and contains two similar entities \(\alpha\) and \(\beta\), coreference (i.e. \(\alpha = \beta\)) arises by default when there is no indication that parts of \(\sigma_{\text{top}}\) contain more than one entity of this type.

As Abusch (2013) points out, the identification of entities in a single situation, \(\alpha = \beta\), may well reflect low-level processes of indexing in vision, see Pylyshyn (2003); as pointed out by Abusch, such extra-linguistic (or pre-linguistic) processes are not in contradiction with the formal semantic approach that we (and Abusch) pursue.

We can now proceed with the coreference sequence in Figure 5 and render (19) as given in (21). We have already established the two satisfaction conditions in (21a) and (21b). By grouping-based coreference, we now derive a larger narratively relevant situation \(\sigma_{\text{top}}\) in (21c) (loosely based on Abusch, 2013); this is a situation that has a subpart \(\sigma_{11}\) and a subpart \(\sigma_{14}\), which each involve existential quantification over a person (\(\alpha\) and \(\beta\), respectively). Since both are part of the same overarching narratively relevant situation, we can, by (20b), identify \(\alpha\) and \(\beta\).

(21) a. \(\sigma_{11}\) satisfies \([P_{11}]\) only if in \(\sigma_{11}\) a person \(\alpha\) is sitting.
   b. \(\sigma_{14}\) satisfies \([P_{14}]\) only if in \(\sigma_{14}\) a person \(\beta\) is holding a spear.
   c. by grouping-based coreference
      a narratively relevant situation \(\sigma_{\text{top}}\) satisfies \([P_{11}-P_{14}]\) only if \(\sigma_{\text{top}}\) has a part \(\sigma_{11}\) such that in \(\sigma_{11}\) a person \(\alpha\) is sitting, and \(\sigma_{\text{top}}\) has a part \(\sigma_{14}\) such that in \(\sigma_{14}\) a person \(\beta\) is holding a spear [via (20a)] and \(\alpha = \beta\) [via (20b)].

The important part here is that \([P_{11}]\) and \([P_{14}]\) in Figure 5 are not separated by a larger-level grouping boundary. Contrast this with the disjoint reference condition in Figure 6, adapted from Figure 4. Here, a larger-level group boundary is introduced between \([P_{23}]\) and \([P_{24}]\) due to a change in orientation and direction.
The satisfaction conditions in (22a-b) are equivalent to those in (21a-b). (We return to the mirroring of the spear holding in [P25] vs. [P14] below.) The crucial difference is that the group boundary between [P23] and [P24] (which, by transitivity, counts as a group boundary between [P21] and [P25]) blocks the inference to a larger narratively relevant situation \( \sigma_{top} \).

(22) a. \( \sigma_{21} \) satisfies [P21] only if in \( \sigma_{21} \) a person \( \alpha \) is sitting.
   
b. \( \sigma_{25} \) satisfies [P25] only if in \( \sigma_{25} \) a person \( \beta \) is holding a spear.

Grouping alone may thus be sufficient to block coreference (i.e. referent identification) in a simple narrative like this one, i.e. identification of the agent in the two situations \( \sigma_{21} \) and \( \sigma_{25} \). An open question (at this point) concerns the exact nature of narratively relevant situations. Since situations are recursively embedded in larger situations, any visual narrative of the type in Figure 6 will contain one larger (non-narratively-relevant) situation that contains \( \sigma_{21} \) and \( \sigma_{25} \). For present purposes, we exclude such top-level situations, but eventually we aim to determine more precisely which levels matter.

Note that, much in line with Schlenker’s (2017a) ideas for the syntax/semantics mapping in music, we propose that grouping in dance serves as a way to organize (sub-)events. Specifically, the introduction of larger-level group boundaries serves to signal discontinuity. Such a signal can have different functions; in other words, it is not necessarily the case that every single grouping boundary indicates a change of character; yet, it is quite plausible that every change of character requires a grouping boundary to be placed.\(^7\)

We can now conclude the discussion of grouping-based coreference and disjoint reference, and move on to a separate question, asking about the types of meaning that are encoded in such dance sequences.

7. Mirroring and the question of at-issueness in dance

If we review Figure 6, we observe that disjoint reference is encoded at several levels (going beyond inferences based on grouping). First, the dancer uses a designated \textit{mudra} (hand-and-arm gesture) that symbolizes ‘another, a different’, as visible in [P22]. She then explicitly introduces a new locus on stage, as visible in [P23], which she then assumes, in [P24]. From

\(^7\) We are grateful to an anonymous reviewer for flagging this point.
the perspective of Abusch’s (2013, 2014, 2015) picture semantics, as applied to visual narrative in dance, we could posit satisfaction conditions such as (23).

(23) a. \( \sigma_{22} \) satisfies \([P_{22}]\) only if in \( \sigma_{22} \), there is an individual \( y \) such that \( y \) is distinct from the most salient individual \( x \).

b. \( \sigma_{23} \) satisfies \([P_{23}]\) only if in \( \sigma_{23} \) there is a virtual locus \( i \).

c. \( \sigma_{24} \) satisfies \([P_{24}]\) only if in \( \sigma_{24} \) the narrative is at the virtual locus \( i \).

In terms of narrative progression, each of (23a-c) seems to redundantly encode disjoint reference (in addition to what is already achieved by grouping). Note that this does not void grouping-based coreference, (20), which was intended as a more general rule (or principle) of narrative dance that also applies beyond conventional aspects of bharathanatyam. However, there are open questions with regards to, in particular, (23b-c): what, if any, is the shared cognitive underpinning of virtual loci in narrative dance on the one hand, and the loci of Sign Languages on the other hand (see Schlenker, 2017c, for an overview)? A particularly promising idea in this regard may be the hypothesis that even sign language loci may at times be “iconic depictions of their denotations” (Schlenker, 2017c:174, building on research such as Liddell, 2003, and the work by Judy Kegl, as in Neidle et al., 2000), in parallel to the dancer’s virtually assuming of the position associated with the new locus in \([P_{24}]\).

More intriguingly, for present purposes, is the role of “mirroring” in \([P_{25}]\), which is illustrated in direct comparison in Figure 7. An initial hypothesis could be that this is a trivial reflection of the orientation change. However, in a post-experimental debriefing with the dancer, this mirroring forms an additional part of ensuring that an audience can follow the narrative, i.e. it is a designated means of marking disjoint reference (in addition to (23a-c)).

![Figure 7: mirroring in Item 1](image)

This naturally raises the question of where in the semantics mirroring could be represented. The satisfaction conditions for \([P_{14}]\) and \([P_{25}]\) are restated in (24a-b), repeated from (21b) and (22b). Crucially, what mirroring may contribute is a non-at-issue inference, as given in (24c) for \([P_{25}]\).

(24) a. \( \sigma_{14} \) satisfies \([P_{14}]\) only if in \( \sigma_{14} \) a person \( \beta \) is holding a spear.

b. \( \sigma_{25} \) satisfies \([P_{25}]\) only if in \( \sigma_{25} \) a person \( \beta \) is holding a spear.
c. **non-at-issue inference (modeled as a definedness condition)**  

σ_{25} is defined for \([P_{25}]\) if and only if the agent of the activity in σ_{25} is distinct from the most salient individual in the current narrative.

Of course, (24c) looks at dance from a linguistic angle, and it is difficult to argue that visual narratives contain something akin to presuppositional content. (For instance, it is rather difficult to conceive how tests for projective content could adequately be carried out.)

Nevertheless, the relationship between \([P_{22-24}]\) and \([P_{25}]\) could be likened to that of \(S_1\) and \(S_2\) in (25). It is a standard assumption that \(S_2\) presupposes the same information that \(S_1\) asserts, due to the definite description (with possessive pronoun) *his sister*. Similarly, we conjecture that \([P_{25}]\) may presuppose the same information that is conveyed ‘at issue’ in \([P_{22-24}]\).

(25) \[S_1 \text{ Bill has a sister.} \] \[S_2 \text{ And *his sister* lives in Tromsø.} \]

In the linguistics literature, there are precedents for non-at-issue content being conveyed outside of speech. For instance, in the realm of speech-accompanying gestures, co-speech gestures (which accompany spoken words) have been argued to encode non-at-issue meaning (see Schlenker, 2017b; Tieu et al., 2017), and Schlenker (2017d) argues that pro-speech gestures (which replace spoken words) can trigger presuppositional inferences (amongst other types of inferences that they can trigger). Moreover, since sign language loci and gestural loci can be linked to presuppositional content (e.g., Schlenker, 2017c:170-171), even the sequence in \([P_{22-24}]\) may be analyzed at the level of non-at-issue meaning.

Before concluding, it is also worth commenting more on the exact rendering of the inference in (24c). An anonymous reviewer points out that grouping breaks (which we discussed in section 6) can be seen as having “the discourse semantic function [of] introducing a new center” (corresponding to the management of a stack of entities in a dynamic semantics). S/he inquires what the type of these centers should be (“a protagonist, a location, a situation, or a combination of them”). For the purposes of the Bharatanatyam narrative that we have been working with, the center seems to be a protagonist/character in the narrative (rather than a location or situation). However, in a broader view (moving beyond Bharatanatyam) it is plausible that centers are more abstract corresponding to virtual sources in the style of Schlenker (2017a); a larger-level grouping boundary would then indicate a shift from one virtual source (on a stack of contextually given entities) to another virtual source.

8 Conclusion

In this paper, we presented an exploratory production study to investigate the encoding of coreference vs. disjoint reference in Bharatanatyam, a figurative (narrative) dance that serves to tell a story. We maintained that a formal semantics of narrative dance is possible in line with Abusch’s (2013, 2014, 2015) approach to the semantics of visual narrative. While our

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8 One test for (non-)at-issueness that may be fruitful involves embedding under negation (or under a negative predicate such as *deny*; we are grateful to Philippe Schlenker for pointing this out). For Item 1, as illustrated in (6b), a relevant item may thus be designed as in (i) below, where the prediction is that the inference in (24c) is not canceled in such a context. We plan to explore such items in future follow-up studies.

i. The witness describes that a strong man was sitting on the ground.

Then she denies that another man was holding a spear.
analysis was closely tied to the nature of Bharatanatyam, we maintain that at least two aspects of the analysis would carry over to other (non-narrative) dance forms:

[i.] dance positions \( P_n \) (as arbitrary discrete moments in dance sequences) can be described by means of satisfaction conditions that involve a fictional virtual source in the spirit of Schlenker (2017a), as illustrated in (18).

[ii.] a larger-level group-boundary between two dance positions \( P_n \) and \( P_{n+1} \) (as triggered in line with grouping preference rules as posited by Charnavel, 2016) triggers discontinuity inferences, which may, for instance indicate non-identity of two virtual sources, see Figure 6.

Open questions to be explored in future studies concern the question of what happens if more than two characters are introduced into a Bharatanatyam narrative; specifically, a question that has arisen from the discussion so far is the extent to which loci in Bharatanatyam can be likened to loci in sign languages. Another goal is to move on to non-figurative dancing and test whether the insights from this study carry over (and to what extent). Here it could also be interesting to investigate to what extent expressive qualities (cf. Krumhansl and Schenck, 1997), as seen in the spatiotemporal features of the gestures (e.g. “jaggedness” in the quality of movement), complement or contradict some of the linguistic meanings. Future studies also need to move on from production to perception, to investigate how observers (both trained and untrained) interpret a given dance sequence, e.g. if and how observers can recognize whether a narrative dance sequence involves one or more protagonists. Moving beyond a sophisticated dance form such as Bharatanatyam, such perception studies would benefit from a shift towards simplified dances/gestures (e.g. using the medium of a simple dance form such as “finger dance” to construct stimuli; see Charnavel, 2016:fn.11).

References


Constraining (shifting) types at the interface¹
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Abstract. This paper argues that traces only range over individual semantic types and cannot be type shifted into higher types to circumvent this restriction. The evidence comes from movement targeting positions where DPs must denote properties and the behavior of definite descriptions in these positions. These constraints on possible traces demonstrate that syntactic operations impose active restrictions on permissible semantic types in natural language.

Keywords: semantic types, traces, movement, reconstruction, type shifting, properties.

1. Introduction

A longstanding problem in semantics is that natural language only makes use of a small subset of the possible semantic types that are generated by the standard recursive definition in (1).

(1) a. e and t are types;
    b. If σ and τ are types, then \(\text{uni} \sigma, \tau\) is a type;
    c. Nothing else is a type.

This paper argues for the hypothesis that, while types are in principle unconstrained in the semantics, syntactic operations only make use of a small set of those possible types and thus impose an active constraint on permissible semantic types. I present a case study on movement, in particular on what constitutes a possible trace, i.e. the \(\lambda\)-bound variables that movement dependencies can map onto. The novel evidence for this study comes from the domain of property-denoting DPs. The argumentation breaks down into two claims. The first claim is that traces only range over individual semantic types, such as entities \((e)\) and degrees \((d)\). Even though natural language has expressions over higher types, like properties \((\text{uni} e, t)\) and generalized quantifiers \((\text{uni} \langle e, t \rangle)\), these expressions cannot be represented as traces. I call this the Trace Interpretation Constraint, given in (2) (see also Chierchia, 1984; Landman, 2006).

(2) Trace Interpretation Constraint
    *\([ DP_1 \lambda f_0 \ldots \ldots [ f_0 ]_1 \ldots ] \], where \(\sigma\) is not an individual type

The second claim is that the Trace Interpretation Constraint cannot be circumvented by type shifting an individual-type trace into a higher type. I call this the Trace Rigidity Principle, given in (3) (see also Landman, 2004).

(3) Trace Rigidity Principle
    Traces cannot be type shifted.

¹This paper stems from my dissertation work in Poole (2017a). For helpful discussion on the specific issues in this paper, many thanks to Rajesh Bhatt, Kyle Johnson, Barbara Partee, and Ellen Woolford, in addition to Daniel Altshuler, Dylan Bumford, Danny Fox, Stefan Keine, Angelika Kratzer, Andrew McKenzie, and audiences at GLOW 40, Sinn und Bedeutung 22, UMass, and UCLA. This work was supported by the National Science Foundation Graduate Research Fellowship under NSF DGE-1451512.

These constraints together conspire to force movement either to map onto a trace ranging over an individual type (4) or to reconstruct by putting the moved expression back in its launching site at LF (5). All other representations are ill-formed. Thus, the interpretation of movement is tightly restricted, which in turn constrains the actively used semantic types.

Addressing constraints on permissible semantic types might appear to (and arguably, traditionally does) belong to the domain of lexical items, namely what the semantic types of possible lexical items are. A premise tacitly defended in this paper is that a theory of permissible semantic types must be based on the semantic types of syntactic constituents, which include both lexical items and complex constituents. In simple cases, the possible types of these two coincide; for example, a verb phrase has the same type as an intransitive verb, \((e, t)\), irrespective of its internal structure. However, movement would prima facie have the ability to create constituents whose semantic type would not correspond to any known lexical items. Thus, a theory of possible lexical items is not in and of itself a sufficient theory of permissible semantic types. Rather, it must be coupled with a theory of possible traces, i.e. which of the logically possible movement structures are allowed by the grammar, which is what this paper provides.

2. Trace Interpretation Constraint

DPs come in three semantic guises (Partee, 1986): entities (type \(e\)), properties (type \((e, t)\)), and generalized quantifiers (type \((et, t)\)). There is abundant evidence that entity traces exist, as these are the canonical traces left by movement types like QR. With respect to generalized-quantifier traces, Romero (1998) and Fox (1999) have shown that such traces are unavailable (contra Rullmann, 1995; Cresti, 1995), based on evidence from the correlation between Condition C connectivity and scope reconstruction. Additional arguments against generalized-quantifier traces based on ACD, extraposition, and parasitic gaps can be found in Poole (2017a: 122–126).

It has not yet been addressed whether property traces exist. Thus, a central contribution of this project is an empirically motivated argument against property traces (see also Poole, 2017a, b).

Properties are intensional, i.e. \((s, (e, t))\), but throughout this paper, I will treat them in purely extensional terms for the sake of simplicity. This reduces them to sets of entities. Chierchia (1984) argues that property variables exist based on anaphora like such and do so. However, Landman (2006) shows that these cases should be reanalyzed as referring to kinds and do not involve property variables.
This investigation thus supplies the crucial final piece of the argument that the constraint on possible traces is against any higher-type trace (9). This is an important advance in our understanding of the syntax–semantics interface.

(9) **Trace Interpretation Constraint**
*\[ \text{DP}_1 \lambda f_0 \ldots [ \ldots [ f_0 ]_1 \ldots ] \], where \sigma is not an individual type*

The crucial motivation for the ban on property traces comes from a series of original observations about what I call \( \Pi \)-positions. These are syntactic environments where a DP denotes a property (type \( (e,t) \)). The four \( \Pi \)-positions that form the investigation’s empirical base are the pivot of an existential construction (10a), the color term of a change-of-color verb (10b), the name argument of a naming verb (10c), and predicate nominals (10d). Despite their surface heterogeneity, what these four environments have in common is that they require a property-type DP.

(10) **\( \Pi \)-positions**

a. There is [a potato\( ]_{(e,t)}\) in the pantry. \hspace{1cm} **Existential constructions**

b. Megan painted the house [magenta\( ]_{(e,t)}\). \hspace{1cm} **Change-of-color verbs**

c. Irene called the cat [Snowflake\( ]_{(e,t)}\). \hspace{1cm} **Naming verbs**

d. Erika became [a teacher\( ]_{(e,t)}\). \hspace{1cm} **Predicate nominals**

For reasons of space, I do not review the arguments that DPs in these positions denote properties. The arguments, however, come from the respective literatures on each of the \( \Pi \)-positions and are thus independent from the arguments made here. For change-of-color verbs, the color term denotes a property because these verbs are textbook examples of resultatives (e.g. Kratzer, 2005). For predicates nominals, them being properties is the standard analysis (e.g. Williams, 1983; Partee, 1986). For existential constructions and naming verbs, the arguments are more involved and come from McNally (1992, 1997) and Matushansky (2008) respectively. As a bibliographic note, I use “\( \Pi \)-positions” as a theory-neutral term because these positions belong to a larger syntactic puzzle observed by Postal (1994), which involves more environments and more movement types than are discussed here. For more about \( \Pi \)-positions in the context of Postal’s puzzle, see Poole (2017a).

The argumentation in this section proceeds as follows: First, I set the stage by showing that movement types in English differ with respect to whether they shift scope, i.e. whether they can reconstruct. Second, I apply these movement types to \( \Pi \)-positions, showing that only movement that reconstructs can target them, which categorically precludes some movement types. Third, I argue that the Trace Interpretation Constraint derives this pattern, from which I conclude that property traces do not exist.

2.1. Movement and scope shifting

For movement to shift scope means that at LF, the moved DP takes scope in the position achieved by movement. For all overt forms of movement, this corresponds to the DP’s surface syntactic
position. If movement does not shift scope, the scope of the moved DP at LF mismatches its surface position in that it takes scope in its position prior to movement, viz. its base-generated position. This dichotomy is schematized in (11) and (12) where the check mark represents the moved DP’s position at LF.

(11) Movement that shifts scope

\[ \boxed{\checkmark \quad 1 \ldots [\ldots \quad 1 \ldots ]} \]

(12) Movement that does not shift scope

\[ \boxed{\quad 1 \ldots [\ldots \quad \checkmark \quad 1 \ldots ]} \]

Against this backdrop, let us consider topicalization, wh-movement, and QR.

**Topicalization:** Topicalization in English obligatorily shifts the scope of the moved DP.\(^4\) To illustrate, first consider the possible interpretations of the baseline sentence in (13), which has narrow-scope and wide-scope readings of some student with respect to every teacher.

(13) Every teacher likes some student in the first week.

a. Narrow-scope reading

For every teacher \(x\), there is some student \(y\) such that \(x\) likes \(y\).

b. Wide-scope reading

There is some student \(y\) such that for every teacher \(x\), \(x\) likes \(y\).

Crucially, in a scenario where the student is a different student for each teacher, only the narrow-scope reading in (13a) is true. Topicalizing some student, as in (14), bleeds the narrow-scope reading in (13a).

(14) [Some student], every teacher likes ___1 in the first week.

\(^*\forall \gg \exists; \quad \exists \gg \forall\)

The only possible interpretation of (14) is the wide-scope reading, where some student takes scope in the landing site of topicalization, above every teacher. Consequently, (14) is true iff there is a single student that every teacher likes. In sum, topicalization obligatorily shifts scope and does not allow reconstruction.

**Wh-movement:** Wh-movement optionally shifts the scope of the moved DP. In order to probe scope in constituent questions, we will use how many-questions because, in addition to the wh-meaning component, how many independently carries its own existential quantification that can vary in scope (Kroch, 1989; Cresti, 1995; Rullmann, 1995). Consider the how many-question in (15). Under the wide-scope, de re reading (15a), it is assumed that there is a certain set of books that Nina should read; the speaker is asking how many such books there are. A possible answer to the wide-scope reading is: ‘Three books, namely Aspects, Lectures on Government.

\(^4\)A few disclaimers are in order: First, this behavior is notably distinct from other movement types called “topicalization” in other languages, e.g. German V2-fronting, which are indeed able to reconstruct. Second, topicalization is the name of a movement type and should not be conflated with topichood. Third, when investigating English topicalization, there are a number of factors that must be controlled for, which I gloss over here in the interest of space. See Poole (2017a: 48–51) for a more in-depth discussion which shows that the relevant facts hold even when the necessary controls are in place.
and Binding, and The Minimalist Program’. Under the narrow-scope, de dicto reading (15b), there is no assumption that there are any specific books that Nina should read. Rather, it is assumed that she should read a certain number of books, without having any particular books in mind. A possible answer to the narrow-scope reading is: ‘Three books, any three’.

(15) [How many books]₁ should Nina read ___₁ this summer?
    a. Wide-scope reading  how many >> should
       For what number n: There are n-many particular books x such that Nina should read x this summer.
    b. Narrow-scope reading  should >> how many
       For what number n: It is necessary for there to be n-many books x such that Nina reads x this summer.

The wide-scope and narrow-scope readings of (15) can be paraphrased as the questions in (16a) and (16b) respectively.

(16) a. Wide-scope paraphrase of (15)
       How many books are there that Nina should read this summer?
    b. Narrow-scope paraphrase of (15)
       What is the number such that Nina should read that many books this summer?

The scope ambiguity in (15) is the result of the fact that wh-movement only optionally shifts scope and thus allows a reconstructed derivation.

Quantifier Raising: By definition, QR cannot reconstruct. However, as a disclaimer, we must distinguish QR for scope shifting and QR for interpreting quantifiers. Although these two functions of QR ordinarily coalesce (at least in English), we will see that this does not hold for Π-positions: quantificational DPs can occur in Π-positions, but they do not enjoy the scopal mobility that QR would afford. For reasons of space, I do not discuss the issue of how to interpret quantificational DPs in Π-positions if not by QR. It is essentially an open question, though see Poole (2017a: 83–87) for discussion and some possible solutions.

2.2. Π-positions

The Trace Interpretation Constraint makes the two predictions about Π-positions in (17). This section shows that both of these predictions bear out for the four Π-positions.

(17) a. Scope prediction
       If movement targets a Π-position, it must reconstruct, because an entity trace is type-incompatible with a property-denoting DP.
    b. Movement-type-prediction
       If a movement type cannot reconstruct, it can never target Π-positions.
**Existential constructions:** Wh-movement can target the pivot of an existential construction (18b), but topicalization (18c) and QR cannot (18d). This confirms the movement-type prediction for existential constructions, because the two movement types that cannot shift scope, topicalization and QR, cannot target the Π-position.

(18) a. There is a potato in the pantry.  
   *Baseline*

   b. What₁ is there ___₁ in the pantry?  
   *Wh-movement*

   c. *[A potato]₁, there is ___₁ in the pantry.  
   *Topicalization*

   d. There must be someone in his house.  
   *QR: must >> ∃; *∃ >> must*

Even though wh-movement can ordinarily shift scope, when it targets the pivot of an existential construction, scope shifting is rendered impossible, and the movement must reconstruct (19).

(19) [How many questions]₁ should there be ___₁ on the exam?  
*how many >> should; should >> how many

To appreciate this fact, let us compare the existential construction in (19) with its corresponding copula construction in (20), where how many is able to scope above or below should. Paraphrases of the (hypothetical) wide-scope and narrow-scope readings of (19) and (20) are given in (21).

(20) *Copula equivalent of (19)*  
*how many >> should; should >> how many

   [How many questions]₁ should ___₁ be on the exam?

(21) a. Narrow-scope paraphrase  
*existential (19); copula (20)  
What is the number such that it is necessary that that many questions be on the exam?

   b. Wide-scope paraphrase  
*existential (19); copula (20)  
How many questions are there such that it is necessary that they be on the exam?

Consider the appropriateness of (19) and (20) in two different scenarios where I am a TA and the professor is preparing the final exam. In the first scenario, she wants to know the number of questions that I think the exam should have so that the grading is manageable; the identity of the questions does not matter at this point. Both (19) and (20) are appropriate in this context because they both have a narrow-scope reading, as paraphrased in (21a). In the second scenario, the professor has asked me to pick out from a workbook the questions that I think should be on the exam. She wants to know the number of questions that I have selected so that she can gauge the amount of time that the exam room should be reserved for. Thus, she is asking about the cardinality of a set that exists in the actual world, the set of questions that I have picked. While the copula construction in (20) is appropriate in this context, the existential construction in (19) is not. This contrast reflects that (20) but not (19) has a wide-scope reading where how many scopes above should, as paraphrased in (21b). This difference follows from the fact that wh-movement cannot shift scope when it targets a Π-position, thereby forcing a narrow-scope, reconstructed reading of how many. This confirms the scope prediction for existential constructions. Further confirmation of the scope prediction comes from negative

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5The observation that QR cannot target the pivot of an existential construction comes from Williams (1984).
islands, which independently block reconstruction (e.g. Rullmann, 1995). Since negative islands force how many to take wide scope and Π-positions force how many to take narrow scope, the two should be mutually exclusive. This prediction is borne out, as shown in (22).

(22)  
   a. *[How many books]₁ aren’t there ___₁ on the table?  
   b. ✓[How many tables]₁ aren’t there books on ___₁?

Change-of-color verbs: Wh-movement can target the color term of a change-of-color verb (23b), e.g. paint, turn, and dye, but topicalization cannot (23c).

(23)  
   a. Megan painted the house magenta.  
       Baseline  
   b. ✓[What color]₁ did Megan paint the house ___₁?  
       Wh-movement  
   c. *Magenta₁, Megan painted the house ___₁.  
       Topicalization

There is no general prohibition against topicalizing color terms. A color term can be topicalized if it does not occur with a change-of-color verb (24). The prohibition on topicalization targeting color terms applies exclusively to those color terms that are arguments of change-of-color verbs.

(24)  
   {Green/that color}₁, he never discussed ___₁ with me.  
       [Postal 1994:164]

QR also cannot target the color term of a change-of-color verb (25a), which we can compare with QR targeting the object (25b), which is indeed possible.

(25)  
   a. A (#different) contractor painted the house every color.  
       ∃ >> ∀; *∀ >> ∃  
   b. A (different) contractor painted every house that ugly green.  
       ∃ >> ∀; ∀ >> ∃

(25a) is true iff there is a single contractor, who incidentally did lots of painting, but not if there is a different contractor for each color. This confirms the movement-type prediction for change-of-color verbs. Turning to the scope prediction, when wh-movement targets the color term, it must reconstruct. Thus, (26) only has the narrow-scope reading, as paraphrased in (26a), and extraction from negative islands is outright ungrammatical (27), thereby confirming the scope prediction for change-of-color verbs.

(26)  
   [How many colors]₁ should Nina paint the house ___₁?  
   a. ✓Narrow-scope paraphrase: What is the number such that it is necessary that Nina paint the house that many colors?  
      ✓should >> how many  
   b. *Wide-scope paraphrase: How many colors are there such that it is necessary that Nina paint the house those colors?  
      *how many >> should

---

6The same fact can be shown with wh-islands; see Poole (2017a: 56–59).
7I include different to bias towards the inverse-scope reading. The #-mark indicates that different is infelicitous if the sentence were uttered out-of-the-blue, because it lacks the inverse-scope reading that would require QR. There is a felicitous reading of (25a) in which different is interpreted as different with respect to something previously mentioned in the discourse, e.g. another contractor, but this reading does not involve inverse scope.
(27)  a. *[How many colors]_1 did no one paint their house ____ _1?
    b. √[How many houses]_1 did no one paint ____ _1 lime green?

Naming verbs: The same pattern is observed for naming verbs and predicate nominals, so here the discussion will be more compact. Wh-movement can target the name argument of a naming verb (28b), e.g. name, call, and baptize, but topicalization (28c) and QR cannot (28d). As with color terms, there is no general prohibition against topicalizing names (29). Finally, when wh-movement targets the name argument, it must reconstruct (30). This confirms the movement-type and scope predictions for naming verbs.

(28)  a. Irene called the cat **Snowflake**.
    
    b. √[What name]_1 did Irene call the cat ____ _1?
    c. *Snowflake_1, Irene called the cat ____ _1.
    d. A (#different) child called the cat **every nickname**.  

(29)  **Raphael** , we never discussed ____ _1 as a possible name for him.  
[Postal 1994:164]

(30)  [How many nicknames]_1 should Nina call the cat ____ _1?
    
    *how many >> should; √should >> how many

Predicate nominals: Wh-movement can target predicate nominals (31b), but topicalization (31c) and QR cannot (31d). Furthermore, when wh-movement targets a predicate nominal, it must reconstruct (32). This confirms the movement-type and scope predictions for predicate nominals.

(31)  a. Erika became a **teacher**.
    
    b. √[What (kind of teacher)]_1 did Erika become ____ _1?
    c. *A math teacher_1, Erika became ____ _1.
    d. A (#different) student became **every kind of teacher**.  

(32)  [How many kinds of teacher]_1 should Nina become ____ _1?
    
    *how many >> should; √should >> how many

2.3. Putting together the pieces

The previous section confirmed the two predictions of the Trace Interpretation Constraint: (i) if movement targets a Π-position, it must reconstruct, because an entity trace is type-incompatible with a property-denoting DP, and (ii) if a movement type cannot reconstruct, it can never target Π-positions. Descriptively, then, what Π-positions reveal is that the semantic representation of scope-shifting movement is incompatible with positions where DPs must denote properties. According to the standard mechanism of interpreting movement (e.g. Heim and Kratzer, 1998), and also the Trace Interpretation Constraint, this follows straightforwardly: the representation of scope-shifting movement involves movement leaving an entity (type e) trace. Leaving a type-e
trace would shift scope, but such a trace does not furnish the property meaning required by \( \Pi \)-positions, yielding ungrammaticality (33). Reconstruction obviates this problem by placing the moved expression back in the launching site of movement at LF. Thus, if a DP would not ordinarily violate the property requirement of \( \Pi \)-positions, then it will not do so under reconstruction either (34).

\[
(33) \quad \text{Scope shifting } \Rightarrow \ \Pi \text{-positions}
\]

\[
*\left[ \text{DP}_1 \lambda x_e \ldots \ldots \ldots [x_e \Pi\text{-pos} \ldots] \right] \\
\text{type } e \text{ trace}
\]

\[
(34) \quad \text{Reconstruction } \Rightarrow \ \Pi \text{-positions}
\]

\[
\checkmark \left[ \ldots \ldots \ldots \left[ \text{DP}_1 \Pi\text{-pos} \ldots \right] \right] \\
\text{reconstruct}
\]

According to this analysis, \( \Pi \)-positions are an instance where movement must reconstruct in order to avoid the semantic-type mismatch that would occur if the moved DP were not interpreted in its base-generated position.

Crucially, the ungrammaticality of scope-shifting movement targeting \( \Pi \)-positions indicates that movement cannot map onto a trace ranging over properties, where the moved DP denotes either a property or a generalized quantifier over properties, as schematized in (35).

\[
(35) \quad \text{Property traces are ungrammatical}
\]

a. \( *\left[ \text{DP}_{(e,t)} \lambda f_{(e,t)} \left[ \ldots f \ldots \right] \right] \)

b. \( *\left[ \text{DP}_{(e,t),t} \lambda f_{(e,t)} \left[ \ldots f \ldots \right] \right] \)

Empirically, if (35a) and (35b) were not ungrammatical, they would derive the wrong scope facts (see above). Moreover, even in instances that involve apparent quantification over properties, these quantifiers over properties cannot take scope over other scope-bearing elements in the sentence, as shown in (36) for existential constructions.

\[
(36) \quad \text{a. There wasn’t every kind of doctor at the convention. } \checkmark \text{not } \gg \text{ every; } *\text{every } \gg \text{ not}
\]

\[
\text{b. There wasn’t only one kind of doctor at the convention. } \checkmark \text{not } \gg \text{ only one; } *\text{only one } \gg \text{ not}
\]

This unavailability of wide-scope is expected if (35b), where a generalized quantifier over properties has undergone QR, is an unavailable representation. Moreover, if a trace ranging over properties is unavailable in (35b), then we can generalize that it is also unavailable in (35a), which completely rules out property traces.\(^8\) Thus, what the ungrammaticality of scope-shifting movement targeting \( \Pi \)-positions ultimately reveals is that the syntax–semantics mapping does not permit movement to map onto traces ranging over properties, in accordance with the Trace Interpretation Constraint.

\(^8\)Strictly speaking, (35a) would not affect quantificational scope and therefore can only be ruled out by deduction. However, the alternative analysis, where (35a) is possible but (35b) is not, would require that movement have some way of knowing the semantic type of the moving expression. I do not see how this would be possible under standard conceptions of syntax and its interface with semantics. According to the analysis here, the only trace that movement can leave is an entity trace, and thus all the configurations in (35) are blocked without having to examine the elements involved in the movement chain.
3. Trace Rigidity Principle

The Trace Interpretation Constraint raises the possibility that the grammar could use an entity trace, but type shift that trace into a higher type, e.g., rendering it compatible with Π-positions. This section argues that such a rescue procedure does not happen and that traces cannot be type shifted, a principle which I call the Trace Rigidity Principle in (37) (or ‘trace rigidity’ for short).

(37) Trace Rigidity Principle
Traces cannot be type shifted.

Without trace rigidity, the Trace Interpretation Constraint would effectively be vacuous and unobservable because it could always be circumvented under the surface. Because the Trace Interpretation Constraint can in fact be observed, there is already reason to believe that trace rigidity holds. However, what this section argues is that there is independent evidence for trace rigidity. I show that anaphoric definite descriptions, a superset of traces under Trace Conversion, cannot occur in Π-positions, but their nonanaphoric counterparts can. Thus, we are able to view the effects of (37) outside the context of movement. I then argue that it is anaphoric definites that cannot be type shifted and develop a syntactic analysis of this incompatibility in terms of the weak–strong definite distinction (in the sense of Schwarz, 2009). The upshot of this proposal is that trace rigidity follows from how DPs are constructed in the syntax.

The point of departure is the observation that at first glance, seemingly type-e elements appear to be able to occur in Π-positions (38). Given the fact that Π-positions require property-denoting expressions, why are the examples in (38) grammatical?

(38) a. Megan painted the house that hideous shade of purple. \textit{Change-of-color verbs}
b. Irene called the cat that dumb nickname. \textit{Naming verbs}
c. Erika became that kind of teacher. \textit{Predicate nominals}

3.1. Type shifting to property

Partee (1986) proposes a set of semantic type shifters that allow DPs to flexibly shift from one of the three possible types to another. The type shifters that are important for our purposes, because they allow shifting into the property domain, are IDENT, PRED, and BE (39).

(39) a. IDENT: \( j \to \lambda x . x = j \)
b. PRED: \( x \to \cup x \)
c. BE: \( \mathcal{P} \to \lambda x . \mathcal{P}([\lambda y . y = x]) \)
\( \mathcal{P} \to \lambda x . \{x\} \in \mathcal{P} \)

The functor IDENT is a total function that maps any element onto its singleton set. The functor PRED maps the entity-correlate of a property onto the corresponding property (Chierchia, 1984). For example, PRED maps \([\text{goodness}]\) to \([\text{good}]\) and \([\text{green}]\) the noun to \([\text{green}]\) the adjective.
$BE$ is a homomorphism between $\langle et, t \rangle$ and $\langle e, t \rangle$. It applies to a generalized quantifier, finds all of the singleton sets therein, and collects the elements of these singleton sets into a set. For more discussion of these type shifters in the context of $\Pi$-positions, see Poole (2017a: 199–204).

I propose that DPs never start out denoting properties. A property denotation is always achieved by type shifting from an individual denotation ($e$) or a generalized-quantifier denotation ($\langle et, t \rangle$). Consequently, $\Pi$-positions require a type shifter for the structure to semantically compose, as schematized in (40), because they require property-type DPs. For the sake of simplicity, I will generally assume that the type shifter used is $BE$, though nothing critical hinges on this.

$$\begin{align*}
\text{(40) } & \text{a. } \text{Existential constructions} \\
\text{There is } [BE(\text{a potato})] & \text{ in the pantry.} & (et, t) \to (e, t) \\
\text{b. } \text{Change-of-color verbs} \\
\text{Megan painted the house } [\text{PRED(magenta)}]. & e \to (e, t) \\
\text{c. } \text{Naming verbs} \\
\text{Irene called the cat } [BE(\text{Snowflake})]. & (et, t) \to (e, t) \\
\text{d. } \text{Predicate nominals} \\
\text{Erika became } [BE(\text{a teacher})]. & (et, t) \to (e, t)
\end{align*}$$

Let us take stock and look ahead. We now have an explanation for why seemingly type-e (and $\langle et, t \rangle$) expressions can occur in $\Pi$-positions: they are type shifted into property meanings. However, thus far, nothing prevents these same type shifters from applying to traces, circumventing the Trace Interpretation Constraint. The next subsection introduces another generalization about $\Pi$-positions: they prohibit anaphoric definite descriptions. I argue that the ban on anaphoric definites and the ban on scope-shifting movement from $\Pi$-positions are one and the same under Trace Conversion, wherein traces are anaphoric definite descriptions. I then propose a syntactic account of the complementarity of type shifting and anaphoric definites.

### 3.2. $\Pi$-positions prohibit anaphoric definites

While some type-$e$ expressions can occur in $\Pi$-positions as a result of property denotations being derived via type shifting, it is not the case that $\Pi$-positions permit all type-$e$ expressions. As such, this means that not all expressions can type shift into property denotations. This section observes that $\Pi$-positions prohibit anaphoric definite descriptions (41). Thus, it must be the case that anaphoric definites cannot be type shifted to type $\langle e, t \rangle$. Following Schwarz’s (2009) terminology, I will call anaphoric definite descriptions strong definites and nonanaphoric definite descriptions weak definites.

$$\begin{align*}
\text{(41) } \text{Definite generalization} \\
\Pi\text{-positions prohibit anaphoric (= strong) definite descriptions.}
\end{align*}$$

Testing for the felicity of strong definites in $\Pi$-positions requires some amount of indirect

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9Poole (2017a: 203–204) suggests that this may explain why property DPs seem to be marked crosslinguistically.
reasoning, which is worth spelling out explicitly. Examples like (38) show that definites are in principle allowed in Π-positions, but they do not reveal what kinds of definites. It is possible to create contexts where only a strong definite would be felicitous. There are two properties that distinguish strong definites from weak definites, which can be used to create such contexts: (i) strong definites must have an antecedent and (ii) they do not have to satisfy the standard uniqueness requirement of (weak) definites (Schwarz, 2009). When these two conditions are satisfied and controlled for, definites become unacceptable in Π-positions. Because definites can occur in Π-positions, but not in these contexts that allow only strong definites, we can reason that it must be the case that the definites in Π-positions are necessarily weak definites. With this logic in mind, I show three pieces of evidence below that support the generalization in (41).

First, a strong definite can refer to a previously mentioned indefinite. In (42a), the definite the shade, or even the color, can refer back to the indefinite a shade of red. In this context, there may be multiple shades or colors that Dorothy finds too dark or other colors that Blanche picked out. Thus, it is not the case that the shade and the color are conveying their referent based on uniqueness. As shown in (42b), a definite description in a Π-position (here, a change-of-color verb) in the same context is infelicitous. What this infelicity discloses is that the definite in (42b) must be a weak definite and its uniqueness requirement is not being satisfied.

(42) Blanche picked out a shade of red for the living room. Color verbs
    a. ♦ But Dorothy thought that the shade/color was too dark.
    b. #And Dorothy painted the room [the shade/color]_Π-pos.

The second piece of evidence is that a strong definite can covary with an indefinite in a quantificational sentence. For example, in (43a), the color or the shade can covary with a color, even though the situations being quantified over, Irene picking out colors, presumably contain more than one color and thus would not satisfy the uniqueness requirement. This kind of covariance requires an anaphoric relationship with the quantifier, which a weak definite cannot achieve. As shown in (43b), a definite description in a Π-position (here, a change-of-color verb) in the same context is infelicitous. As above, this infelicity indicates that the definite in (43b) must be a weak definite and its uniqueness requirement is not being satisfied.

(43) Every time Irene picks out a color for the bathroom, . . . Color verbs
    a. ♦ Helen complains that the color/shade is too bright.
    b. #Helen has to paint the room [the color/shade]_Π-pos.

(44)–(46) show that the same contrast holds for the other Π-positions as well.

(44) In every hotel room with an ugly lamp, . . . Existential constructions
    a. ♦ the lamp is on the dresser.
    b. #there is [the lamp]_Π-pos on the dresser.

---

10 Not all of the data is given here, for reasons of space; see Poole (2017a: 204–212).
Every time that my mom found a new puppy name, ...

a. my dad vetoed the name.

b. #she nicknamed the family dog [the name]_{\Pi-}\text{-pos}.

In every store with a rare type of plant, ...

a. my aunt bought the rare type.

b. #my aunt bought a plant that was [the rare type]_{\Pi-}\text{-pos}.

The third piece of evidence is that while the previous two sets of examples show that strong definites are ungrammatical in \(\Pi\)-positions, the inverse can likewise be observed: weak definites are grammatical in \(\Pi\)-positions. There are certain contexts that require a weak definite. One such context is bridging contexts where there is a part–whole relation between a definite description and the individuals and events in the preceding discourse, which is sufficient to satisfy the uniqueness requirement of the (weak) definite (Schwarz, 2009). (47) shows that part–whole bridging contexts allow definite descriptions in \(\Pi\)-positions (here, an existential construction).

A: What did you like about the fridge?
B: Well, there was [the spacious vegetable crisper]_{\Pi-}\text{-pos}.

We now have two generalizations about what is not allowed in \(\Pi\)-positions: the scope generalization (48a), which reduces to an incompatibility with type-\(e\) traces, the only type of trace available according to the Trace Interpretation Constraint, and the definite generalization (48b).

a. **Scope generalization**
Movement that shifts scope cannot target \(\Pi\)-positions.

b. **Definite generalization**
\(\Pi\)-positions prohibit anaphoric (= strong) definite descriptions.

I propose that these two generalizations are one and the same because “traces” are in fact anaphoric definite descriptions, i.e. strong definites. The idea that traces are related to anaphoric definite descriptions is quite old; see Engdahl’s (1980, 1986) early work on the semantics of questions. However, the idea is best known now as Trace Conversion, according to which downstairs copies of moved DPs are rendered interpretable at LF by converting them into definite descriptions with a variable (49) (Sauerland, 1998, 2004; Fox, 1999, 2002, 2003).

a. **Standard traces**
[ [ [ every cat ]_1 \lambda x [ a child adopted [t_x]_1 ] ] ]

b. **Traces as anaphoric definites**
[ [ [ every cat ]_1 \lambda x [ a child adopted [the cat x]_1 ] ] ]

The technical apparatus performing this operation is a special LF rule that comprises two parts: insertion of a variable (50a) and determiner replacement (50b). The inserted variable is bound by the \(\lambda\)-abstraction introduced below the landing site of movement.
Trace Conversion

\[ \text{Variable Insertion} \]
\[(\text{Det}) \text{Pred} \rightarrow (\text{Det}) \left[ \left[ \text{Pred} \right] \left[ \lambda y . y = g(n) \right] \right] \] (where \( g \) is the assignment function)

\[ \text{Determiner Replacement} \]
\[(\text{Det}) \left[ \left[ \text{Pred} \right] \left[ \lambda y . y = g(n) \right] \right] \rightarrow \text{the} \left[ \left[ \text{Pred} \right] \left[ \lambda y . y = g(n) \right] \right] \]

The result of Trace Conversion is that traces are anaphoric definite descriptions, which allows the scope generalization to be subsumed under the definite generalization. Accordingly, the Trace Rigidity Principle can be recast as (51) to encompass this combined generalization.

\[ \text{Trace Rigidity Principle (revised)} \]
Traces cannot be type shifted.
\( \sim \) Anaphoric definite descriptions cannot be type shifted.

3.3. Anaphoric definites and type shifting

Under the revised version of the Trace Rigidity Principle in (51), the question of why strong definites (including traces) are disallowed in \( \Pi \)-positions translates into the question of why strong definites cannot be type shifted into property denotations. One possibility that can be immediately set aside is linking the incompatibility directly to anaphoricity. Many of the infelicitous examples of definite descriptions in \( \Pi \)-positions are improved when \textit{the} is replaced with \textit{that}, as illustrated in (52) with a change-of-color verb.

\[ \text{Blanche picked out a shade of red for the living room.} \]

a. #And Dorothy painted the room \( [ \text{the shade/color} ]_{\Pi\text{-pos}} \).

b. \( \checkmark \) And Dorothy painted the room \( [ \text{that shade/color} ]_{\Pi\text{-pos}} \).

While a definite description \textit{the NP} cannot establish an anaphoric relation in a \( \Pi \)-position (52a), \textit{that NP} can do so (52b). It is not entirely clear where \textit{that NP} fits within the strong/weak definite distinction, but (52) nevertheless shows that anaphoricity alone cannot be responsible for trace rigidity. Rather, it must be something specific about definite descriptions with the determiner \textit{the}. In this section, I develop a syntactic analysis of the Trace Rigidity Principle, capitalizing on one aspect that has been argued to differ between strong and weak definites: their determiners.

Schwarz (2009) proposes that the strong/weak definite distinction results from having two separate definite determiners (53). In (53), I provide Schwarz’s more standard denotations that return an expression of type-\( e \) and also denotations that return a generalized quantifier.\(^{11}\) Both determiners are associated with uniqueness, represented by the \( \iota \)-operator. However, the strong-definite determiner also has an index (53). The anaphoricity of the strong-definite determiner derives from the index, which can be bound or valued contextually in the same manner as a pronoun, thereby picking out a particular referent rather than relying on uniqueness alone.

\(^{11}\text{Schwarz’s (2009) denotations are intensional and include a situation variable. As I have been assuming an extensional system, I have simplified the denotations.} \)
Schwarz’s (2009) weak and strong definite determiners

a. \[
\text{\text{\text{WEAK}}} \equiv \lambda P(x,t) \cdot Ix[P(x)] = \lambda P(x,t) \lambda Q(x,t) \cdot Q(Ix[P(x)])
\]

b. \[
\text{\text{\text{STRONG}}} \equiv \lambda y e \lambda P(x,t) \cdot Ix[P(x) \land x = y] = \lambda y e \lambda P(x,t) \lambda Q(x,t) \cdot Q(Ix[P(x) \land x = y])
\]

In some languages, the weak-definite and strong-definite determiners have unique realizations or are individually subject to special morphological operations. For example, in German, the determiner in weak definites contracts with prepositions (subject to gender and case), but not in strong definites (54) (Schwarz, 2009).

(54) German strong/weak definite distinction

In jeder Bibliothek, die ein Buch ber Topinambur hat, sehe ich in every library that has a book about topinambur has look I
{\#im / \ 'in dem } Buch nach, ob man Topinambur grillen kann.

\{in.the\text{\text{WEAK}} in the\text{\text{STRONG}} book \text{PRT} whether one topinambur grill can

‘In every library that has a book about topinambur, I check in the book whether one can grill topinambur.’

[Schwarz 2009:33]

Crucially, Trace Conversion requires the strong-definite determiner in order to establish a connection between the upstairs moved DP and the downstairs definite description. Within the strong/weak definite distinction, Trace Conversion, however, operates somewhat differently. Rather than having two separate rules, one for inserting a variable and another for replacing the determiner, there is only a single rule that replaces the determiner in the downstairs DP with the strong-definite determiner, as this determiner contains the variable, i.e. the index. The index is what is then bound by the \(\lambda\)-abstraction created by movement, as schematized in (55).

(55) Trace Conversion with the strong-definite determiner

\[
[\text{DP}_1 \lambda x \ldots [\ldots [\text{DP} \text{\text{\text{STRONG}}} \text{NP}_1 \ldots ]]]
\]

The syntactic analysis of trace rigidity breaks down into two pieces. First, I propose that the weak-definite and strong-definite determiners occupy distinct syntactic positions in the functional structure of a nominal. The strong-definite determiner occupies D0 (56), and the weak-definite determiner occupies some lower functional head, which I label n0 for convenience (57).1213 In English, n0 raises to D0 to form a complex head, which spells out as the regardless of whether n0 or D0 is the head that contains the determiner (58).

12The determiner that might also be in n0, explaining why that NP can occur in II-positions in anaphoric contexts.
13The structures in (56) and (57) might fit into a more articulated nominal structure like that of Zamparelli (2000). For similar proposals that the strong/weak definite distinction is syntactically encoded, see Patel-Grosz and Grosz (2017) and Cheng et al. (2017).
The denotations of the definite determiners in (53) do not permit an \( nP \) headed by \( \text{theWEAK} \) to serve as the semantic argument of \( \text{theSTRONG} \). Therefore, a given DP can only contain one of the definite determiners.

The second piece of the proposal is that nominal type shifters also occupy \( D^0 \), competing with the strong-definite determiner for the same syntactic slot. As such, a DP can either include the strong-definite determiner or a nominal type shifter, but never both. This complementary distribution has two crucial consequences. First, a definite description that has been type shifted is necessarily a weak definite because the only definite determiner that can occur alongside a type shifter is \( \text{theWEAK} \) (59). This accounts for the observation from section 3.2 that definite descriptions in \( \Pi \)-positions are infelicitous in contexts that only license strong definites and hence are necessarily weak definites.

Second, Trace Conversion and type shifting cannot apply to one and the same DP. In a \( \Pi \)-position, it is a lose-lose situation. On one hand, if the converted trace contains a type shifter to achieve the required property denotation, the only definite determiner available is \( \text{theWEAK} \), which has no variable for the \( \lambda \)-abstraction to bind (60). The result is vacuous quantification and thus ungrammaticality. On the other hand, if the converted trace contains the strong-definite determiner, there is a variable for the \( \lambda \)-abstraction to bind, but the DP does not denote a property and runs afoul of the property requirement of \( \Pi \)-positions (61). Consequently, because either option results in ungrammaticality, the only option left for movement targeting a \( \Pi \)-position is to reconstruct.

\[ \begin{array}{l}
\text{(60) } \ast [ \mbox{DP}_1 \lambda x \ldots [ \mbox{DP} \ BE \ [nP \ \text{theWEAK} \ NP ] ]_{\Pi\text{-pos}} ]
\end{array} \]

- Property
- Quantification

\[ ?? \text{no variable to bind} \]

---

To use \( BE \) for weak definites requires that \( \text{theWEAK} \) return a generalized quantifier or that \( D^0 \) can be \( BE \circ LIFT \). (53a) provided a denotation for \( \text{theWEAK} \) that returns a generalized quantifier.
This analysis manages to derive both the definite generalization and the scope generalization from one stipulation, namely the complementary distribution of the strong-definite determiner and nominal type shifters. One might wonder whether there is any independent reason to believe that the strong-definite determiner and nominal type shifters should be in complementary distribution. An idea that floats around in the literature is that English the is an overt type shifter, e.g. a overt ι-operator or an overt encoding of the “natural” type shifter Ω (e.g. Partee, 1986; Chierchia, 1998). If this were to hold of the strong-definite determiner, then it would compete with the property-yielding type shifters for the D⁰ slot because it is itself a type shifter.

4. Conclusion

In this paper, I have presented a case study on what constitutes a possible trace, arguing for the two following constraints on interpreting movement:

\[(62) \text{Trace Interpretation Constraint} \]
\[
*[\text{DP}_1 \lambda x \ldots [D\text{P the\text{STRONG}} [n\text{P }n^0 \text{NP}]_1 ]_{\Pi\text{-pos}}] \]

\[(63) \text{Trace Rigidity Principle} \]
Traces cannot be type shifted.

The paper began with the problem of the standard recursive definition of semantic types overgenerating. The Trace Interpretation Constraint and the Trace Rigidity Principle demonstrate that movement is one domain in which the grammar only makes use of a small set of the possible types, namely the individual types. I would like to suggest that this is representative of the role that syntactic operations—and perhaps the properties of those operations, like economy—play in restricting the actively used semantic types. That is, while semantic types might be in principle unconstrained in the semantics, they are actively constrained by different modules of grammar.

References

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Partee (1986) is agnostic about where type shifters live in the grammar. According to this analysis, at least some type shifters exist in the narrow syntax because they are in complementary distribution with the strong-definite determiner. We might take this as evidence that type shifters exist only in the syntax as determiners and that type shifting is not a last-resort mechanism to repair type mismatches.
Embedding non-restrictive relative clauses
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Abstract. Schlenker (2010) recently provided data from English and French suggesting that, contrary to standard assumptions (McCawley, 1982; Potts, 2005; Arnold, 2007; AnderBois et al., 2011), non-restrictive relative clauses (NRCs) can take narrow scope under operators of the sentence within which they are embedded. This paper presents three experiments in German confirming this claim. The results show that embedded readings are available with NRCs in German and give first insights into the puzzle under which conditions these embedded readings do or do not show up.

Keywords: relative clauses, appositives, projection, rhetorical relations.

1. Introduction

1.1. Standard assumptions

Standardly, it is assumed that non-restrictive-relative clauses (NRCs), despite their embedded position, do not contribute to the truth-conditions of the sentences they are embedded within (their host-clause) but are interpreted similar to independent matrix clauses involving a discourse pronoun (Sells, 1985; Potts, 2005; Arnold, 2007; Nouwen, 2007; AnderBois et al., 2011). Indeed, NRCs pattern quite consistently with their discourse anaphoric matrix clause paraphrases. For example, (1a) roughly can be paraphrased by (1b), but not by (1c).

(1) (Adapted from Schlenker (2013: 7))
   a. If Peter called the dean, who hates me, I would be in deep trouble.
   b. ≈ If Peter called the dean, I would be in deep trouble. He hates me.
   c. ̸≈ If Peter called the dean and he hated me, I will be in deep trouble.

This sticky wide-scope behavior of NRCs has long been taken as evidence for the assumption that NRCs attach high up in the syntactic tree (McCawley, 1982) or even represent syntactic orphans that are only loosely connected to their host-clause at surface structure (Safir, 1986; Fabb, 1990; Espinal, 1991). Alternatively, it has been assumed that NRCs are attached to their anchor at DP-level (e.g. to the dean in (1a)), but contribute projective content (content which is interpreted independently of the main-clause assertion), either because it is semantically interpreted at a different dimension (e.g. as non-at-issue content, Potts (2005)) or because it does not relate to the current question under discussion of the discourse (Simons et al., 2011).

Most of the projection approaches are motivated by the observation that NRCs take widest scope but differ from matrix clause information in their information status (Potts, 2005; AnderBois et al., 2011; Simons et al., 2011). For example, NRCs, unlike assertive (at-issue) content, often cannot be directly denied and in many cases only make poor answers to a direct question.

1.2. Recent challenges

Schlenker (2010, 2013), however, provided examples from English and French, in which the NRCs take narrow scope with respect to operators of the host-clause and in this case contribute conjunctively to the truth-conditions of the complex sentence.

\[ (2) \quad \text{(Adapted from Schlenker (2013: 7))} \]
\[ a. \quad \text{If Peter called the dean, who then called the chair, I would be in deep trouble.} \]
\[ b. \quad \not= \Rightarrow \text{The dean called the chair. \quad (wide scope)} \]
\[ c. \quad \not= \Rightarrow \text{If Peter called the dean, the dean would call the chair. \quad (modally subordinated)} \]
\[ d. \quad = \Rightarrow \text{If Peter called the dean and the dean called the chair, I would be in trouble. \quad (narrow scope)} \]

The NRC in (2a), for example, does not tell us that the dean called the chair (global reading), it does not even have the reading that in any case in which Peter called the dean, the dean would call the chair (which would be equivalent to a potential modal subordination reading), it really seems to have the reading that the speaker only would be in trouble, if Peter called the dean and the dean (happened to) call the chair (local reading), which is comparable to the interpretation of a local conjunction. As Schlenker (2010, 2013) notes, the sentence is ungrammatical if the NRC is replaced by a parenthetical (3a) or a postponed matrix clause (3b), since in these cases the past tense is no longer bound by the conditional. This provides quite a strong argument for the assumption that the NRC in (2a) is indeed interpreted locally.

\[ (3) \quad \text{(Adapted from Schlenker (2013: 7))} \]
\[ a. \quad ^*\text{If Peter called the Dean (he then called the Chair), I would be in deep trouble.} \]
\[ b. \quad \text{If Peter called the Dean, I would be in deep trouble. ^*He then called the chair.} \]

Empirical evidence for these embedded readings, however, is rather rare. Schlenker (2013) only reports judgements of very few English and French speakers. Data from other languages is missing completely. Moreover, it still is quite a puzzle under which conditions embedded readings are acceptable, or put otherwise, what makes the difference between (1a) and (2a). Note that (1a) is getting ungrammatical as soon as we turn the NRC’s predicate into past-tense (Schlenker, 2013: 7).

\[ (4) \quad ^*\text{If Peter called the Dean, who hated me, I would be in trouble.} \]

With the experiments reported in this paper, we will provide a first empirical evidence for the existence of such embedded readings in German and try to test some factors that might affect the embeddability of NRCs in German.

1.3. Potential factors affecting embeddability

Schlenker (2013), himself, makes two crucial observations concerning the embeddability of NRCs. First, he observes that the embeddability is dependent on the position of the NRC in its
host-clause. Embedded readings are best available if the NRC is located at the right edge of the host-clause (in this case at the right edge of the antecedent of the conditional).

(5) Schlenker (2013: 46)
   a. If tomorrow John sent a 2 carat diamond to Ann, who got all excited as a result, he would have a better chance of marrying her.
   b. (#) If tomorrow Ann, who got all excited as a result, received a 2 carat diamond, he would have a better chance of marrying her.

Moreover, he notes that, even if we keep the NRC at the right edge of its host-clause, embedded readings are not necessarily available. Note that the ungrammatical NRC in (4) (repeated here as (6b)) is located at the same position as the grammatical one in (2a) (repeated here as (6a)).

(6) a. If Peter called the Dean, who then called the Chair, I would be in deep trouble.
   (NARRATION)
   b. *If Peter called the Dean, who hated me, I would be in deep trouble.
   (EXPLANATION)

But what makes the difference between (6a) and (6b)? At first sight, the two NRCs differ at least in (i) the predicate-type of the NRC (state/event) and (ii) the presence/absence of the anaphoric expression "then". Moreover, Schlenker (2013) observes that the two sentences additionally differ with respect to the rhetorical relation (Asher and Vieu, 2005) the NRCs establish with their host-clauses. While in (6a) the event described in the NRC follows in time the event described in the antecedent of the if-clause and the NRC, hence, establishes a kind of Narration relation with its host-clause, the NRC in (6b) seems to provide sort of an Explanation for the assumption asserted in the main clause that the speaker would be in trouble if Peter called the dean. According to Asher and Vieu (2005), Narration is a coordinating rhetorical relation while Explanation is subordinating. A possible hypothesis might be that the contrast reported in (6) is due to a contrast between NRCs expressing two different types of rhetorical relations (coordinating vs. subordinating). These observations are particularly interesting for German, for which Holler (2005) distinguishes between two types of non-restrictive relative clauses, appositive and continuative relative clauses, which differ in the position and the rhetorical relation they hold with respect to their host-clause. While appositives can be found in sentence internal and sentence final position and typically express a subordinating rhetorical relation (e.g. EXPLANATION or BACKGROUND), continuatives are characterized by a sentence-final position, establish a coordinating rhetorical relation with their matrix clause (such as NARRATION or RESULT) and typically describe an event which follows in time the event described in the matrix clause. Often continuatives come with an explicit "then" or "as a result" marking the coordinating link to the sentence to which they are attached. Since continuative NRCs typically relate two events, Holler (2005) assumes that state-predicates are degraded in continuative NRCs, as well as in their matrix clauses. Another immediate hypothesis that emerges from Schlenker’s data might be that only continuatives (Holler, 2005) can be embedded.2

Note, however, that the analysis suggested in Holler (2005) does not make correct predictions about the embeddability of NRCs. Based on differences in position and prosody between the two types of NRCs, Holler (2005)
With three experiments in German, we tried to address the following questions: (Q1) Are embedded readings available for (host-final) NRCs in German? (Q2) And if so, is the embeddability dependent on (…) (a) the presence or absence of anaphoric elements (then) relating NRC and host-clause, (b) the predicate-type of the NRC, (c) the type of rhetorical relation (coordinating vs. subordinating) holding between the NRC and host-clause, or (d) on the type of the NRC (continuative vs. appositive in the sense of Holler 2005)?

2. Experiments

To test the availability of embedded readings, we set up three web-questionnaires (SoSciSurvey) in which we presented the test-sentences together with a context-story. The participants were told to imagine a scenario in which pupils were asked to summarize the information given by a story without leaving out or adding crucial information. The participants had to judge whether or not certain sentences of the pupils (the test-sentences) were appropriate as part of a summary of the respective context-stories. Each story was constructed such that the wide-scope reading (and a potential modal subordination reading) of the target sentence was explicitly ruled out. Thus, if the participants only got a wide-scope reading, they were expected to judge the sentence as inappropriate as part of a summary of the context story.

2.1. Experiment 1

In a first experiment, with 62 German native speakers, we tested the availability of embedded readings depending on the CLAUSE-TYPE of the embedded construction (NRCs, conjunctions, V2-parenthetical) and the PREDICATE type (event vs. state).

2.1.1. Design

The survey consisted of 18 test-items in six conditions in which we compared the interpretations of NRCs to those of the corresponding conjunctions and verb-second-parentheticals. In addition to the CLAUSE-TYPE, we manipulated the PREDICATE-type of the examples (event, state). The items were tested interspersed with 24 filler items in a pseudo-randomized Latin square design such that every participant judged every condition three times, but each item only in one condition. (7) gives an example for a test-item in all conditions.

suggests that appositives are attached at DP-level, while continuatives are attached much higher, at CP-level. According to this analysis, one would expect that, if at all, only appositives (and not continuatives) could take narrow scope. The data reported in Schlenker (2013), by contrast, suggest just the opposite pattern.
Geschichte (Story):

Gerd wurde von einer Schlange gebissen und hat nur wenig Chancen zu überleben. Denn das Gift wirkt schnell tödlich. Wenn überhaupt, kann er nur noch Dr. Meier erreichen, der ganz in der Nähe wohnt. Ob dieser jedoch über das äußerst seltene Gegengift verfügt, ist mehr als ungewiss. Nur falls Dr. Meier ihm noch rechtzeitig das richtige Gegengift verabreicht, kann er gerettet werden.

(Gerd got bitten by a snake. There is only little chance that he will survive. The venom is quite deadly. His only chance is to reach Dr. Meier in time, who lives close by. But it’s quite unlikely that Dr. Meier has got the antidote Gerd needs. Only if Dr Meier gives him the antidote in time, can Gerd be saved.

Aus der Zusammenfassung des Schülers (Part of the pupil’s summary):

Wenn Gerd rechtzeitig Dr. Meier erreicht (If Gerd reaches Dr. Meier in time)

a. (NRC/event)
   , der ihm das passende Gegengift verabreicht,
   , who gives him the right antidote,

b. (and/event)
   und der ihm das passende Gegengift verabreicht,
   and he gives him the right antidote

c. (parenthetical/event)
   (der verabreicht ihm das passende Gegengift),
   (he gives him the right antidote)

d. (NRC/state)
   , der über das passende Gegengift verfügt,
   , who has got the right antidote available,

e. (and/state)
   und der über das passende Gegengift verfügt,
   and he has got the right antidote available,

f. (parenthetical/state)
   (der verfügt über das passende Gegengift),
   (he has got the right antidote available),

kann Gert gerettet werden.

Gert can be saved.

According to the context story in (7), it is unclear, whether Gerd can be saved even if he reaches Dr. Meier, since we don’t know whether Dr. Meier has got the right antidote available. Thus, if the participants only got a wide-scope or modally subordinated reading for the NRC in (7a) (as expected for (7c)), according to which Gerd is saved as soon as he reaches Dr. Meier (since in this case he will inject him the antidote), they were expected to reject the target as part of a summary of the story. Only if the participants interpreted the NRC as contributing to the antecedent of the if-clause (such as the conjunction in (7b)), were they expected to accept the target as a summary of the context-story.

In all items the NRCs were presented in clause-final position of the antecedent of the conditional. Unlike in English, relative clauses in German are always obligatorily marked
by comma. To ensure that the relative clause is interpreted non-restrictively, the relatives throughout are attached to proper name heads (e.g. "Dr. Meier"), which should rule out a restrictive interpretation. Additional discourse particles or anaphors in the NRC were deliberately omitted. Parentheticals were graphically marked by setting them off with brackets. Note that in German, relative pronouns and discourse pronouns are homophonous. NRCs and parentheticals, however, are clearly disambiguated by word order. Whereas parenthetical constructions are obligatorily marked by verb-second word-order, NRCs, like other embedded clauses in German, are obligatorily verb-final.

2.1.2. Predictions:

If NRCs invariantly take widest scope, all NRCs should be rejected since the context stories were designed to rule out wide scope interpretations. If NRCs, however, are flexible in scope (Schlenker, 2013), one might assume that at least in some conditions NRCs are judged as acceptable. Under the hypothesis that embedded readings of NRCs are only available with coordinating rhetorical relations (Schlenker 2013) or continuative NRCs in the sense of Holler (2005), we should expect to find a contrast between the conditions with state and event predicate. The test-sentences with conjunctions and parentheticals were used as positive and negative controls. Parentheticals, according to standard assumptions, only have wide scope interpretation and hence should be rejected independently of the predicate-type. Conjunctions, by contrast, only should have embedded readings and be accepted independently of the predicate-type.

2.1.3. Results:

The results of Experiment 1 indicate that NRCs with an event predicate can indeed be interpreted as truly embedded. Although, as expected, a small subset of participants (6) re-

3Filler items consisted equally of a context story and a sentence summarizing it either correctly or incorrectly, but did not contain relative clauses.
jected all embedded readings of NRCs, NRCs with event predicates still got overall acceptance rates about 49 percent, lower than the corresponding and-clauses (0.92), but significantly higher than the corresponding matrix-clause-parenthetical (0.21). NRCs with state predicate, by contrast, rated nearly as low (0.25) as the corresponding matrix-clause parenthetical. Fitting a mixed model regression with CLAUSE-type and PREDICATE-type as fixed effects and random effects for items and participants with the corresponding slopes, we found a highly significant effect of CLAUSE type (p < 0.001) as well as a significant effect of PREDICATE type (p < 0.001). Event-NRCs got accepted in about 49 percent of all cases, less often than the conjunctions (0.92), but significantly more often than the parenthetical (0.21). State-NRCs rated nearly as low (0.25) as the parentheticals. The interaction of CLAUSE-type and PREDICATE-type didn’t reach significance in the overall data. We therefore fitted separate models testing the effect of PREDICATE-Type for each CLAUSE-type separately. Only for the subset of trials with NRC CLAUSE-type the effect of PREDICATE type turned out to be significant (p < 0.01). No significant effect of PREDICATE-type could be found in the subsets with conjunctions and parentheticals. Whereas, as expected, the conjunctions, independently of the predicate type rated consistently high, the corresponding matrix clause parenthetical rated rather low with both state or event predicate. A highly significant contrast (p < 0.001) between NRCs with event predicate and the corresponding matrix clause parenthetical indicates that the observed embeddability is not only a discourse effect or a last resort repair strategy but the result of a structural embedding of the NRCs.

2.1.4. Discussion:

The results confirm the observation made by Schlenker (2009/2013) that NRCs, contrary to standard assumptions, can indeed get embedded interpretations, at least if they are of event predicate type. NRCs rated significantly higher than the corresponding parentheticals, at least if they are of event predicate type. NRCs rated significantly higher than the corresponding parentheticals. This might indicate that there is a true structural difference between NRCs and parentheticals with respect to their embeddability. The fact that the NRCs got lower acceptance rates than the corresponding conjunctions can be accounted for if we consider that the former, in contrast to the latter, are ambiguous between an embedded and a wide scope (or modal subordination) reading. Unlike with parentheticals and conjunctions, the availability of embedded readings improved significantly if the NRC was of event-predicate type. We will discuss several possible explanations for this effect in the introduction part to Experiment 3. Unexpected was the relatively high acceptance rate for V2-parentheticals. According to standard assumptions, parentheticals always take widest scope and should not contribute conjunctively to the antecedent of a conditional. To rule out that this relatively high acceptance rate marks the noise level in our experiment, we decided to run a follow-up study in which we compared the interpretation of NRCs with those of postponed matrix clauses. Postponed matrix clauses definitely should resist an embedded interpretation.

4 Generalized linear mixed model fit by the Laplace approximation, Formula: Answer ∼ Clause * Predicate + (1 + Clause + Predicate |Person) + (1 + Clause+ Predicate |Item).

5 Indeed a good number of participants noted in their comments that both readings (wide and narrow scope) were available for them, but that they decided to reject the target-sentence because the pupil could have taken more care to make explicit which of the two readings she had intended in her summary.
2.2. Experiment 2

For Experiment 2, we took a subset of 12 out of the 18 items of Experiment 1 and this time compared the interpretation of the NRCs to the interpretation of the comparable postponed matrix clauses (CLAUSE-TYPE), again each with event and state PREDICATE-TYPE.

2.2.1. Design

As before, the test-items were presented randomized over a Latin square design such that each participant judged each item only in one condition but each item was tested all conditions. (8) gives an example for a test-item with event-predicate. Task and context story were comparable to those used for Experiment 1.

(8) a. Wenn Gerd rechtzeitig Dr. Meier erreicht, der ihm das passende Gegengift verabreicht, kann er gerettet werden. (If Gerd reaches Dr. Meier in time, who gives him the right antidote, he can be saved.)
   (NRC/event)
   b. Wenn Gerd rechtzeitig Dr. Meier erreicht, kann er gerettet werden. Der verabreicht ihm das passende Gegengift. (If Gerd reaches Dr. Meier in time, he can be saved. He gives him the right antidote.)
   (Matrix/event)

2.2.2. Results

As expected, the postponed matrix clauses got only very low acceptance rates (0.09 overall), ruling out that the acceptability rates for NRCs and parentheticals in the first experiment were only due to the relatively high complexity of the experimental taks. Just as in the first experiment, the NRCs reached an acceptance rate of 41 percent overall. Again the NRCs with event predict rated much higher (0.51) than the NRCs with state predicate (0.29). A mixed model regression with the interaction of CLAUSE-type and PREDICATE-type as fixed effects and the
corresponding random effects for items and participants confirms these observations. Overall, we found a significant effect of clause-type (p < 0.001) as well as a significant interaction of clause-type and predicate-type (p < 0.01), such that event predicates improved the ratings of NRCs while the predicate type had no effect on the ratings of the corresponding matrix clauses.

2.2.3. Discussion

The direct comparison with postponed matrix clauses confirmed the embeddability of NRCs. As in the first experiment, embedded readings were accepted for a good proportion of NRC trials. In contrast to the parentheticals in the first experiment, the acceptance rate of postponed matrix clauses dropped almost to zero, confirming that the acceptance rates for NRCs are indeed a reliable indicator for the availability of embedded readings. Just as reported for the first experiment, NRCs with event predicate were much more likely to be interpreted with narrow scope than those with state predicate.

2.3. Experiment 3

The results of Experiments 1 and 2 indicate that the embeddability of NRCs improves significantly if the NRC is of event predicate type. To make a first step in explaining this effect of predicate-type, we decided to set up a third questionnaire designed to tease apart the following potential explanations:

(i) Rhetorical Relations: Schlenker (2013) assumes that the embeddability of an NRC might be dependent on the rhetorical relation (Asher and Vieu, 2005) it establishes with its host-clause. A first guess, hence, would be that by manipulating the predicate type, we manipulated the type of the rhetorical relation holding between the NRC and its host-clause. The test-items of Experiments 1 and 2 were constructed such that all explicit indicators (such as discourse particles or additional anaphoric material) for the rhetorical relation holding between NRC and the clause embedding it were deliberately omitted. Nevertheless, the manipulation of the predicate-type certainly affected the rhetorical relation holding between the NRC and the host-clause. The most salient rhetorical relations for our event-conditions were coordinating relations such as narration or result, while in the state-conditions the NRCs most plausibly were related by subordinating relations such as explanation or background. A first hypothesis, hence, could be that embedded readings are only available with coordinating relations.

(i) Structural Ambiguity:
A closely related but much stronger hypothesis would be that the observed contrasts are due to a structural difference between appositive and continuative relative clauses in the sense of Holler (2005).

\[ \text{Generalized linear mixed model fit by the Laplace approximation, Formula: Answer } \sim Type \times Condition + (1 + Type \times Condition | Person) + (1 + Type \times Condition | Item). \]
(ii) Causal Relation:
NARRATION and RESULT are not only coordinating but also causal relations, in which the occurrence of the second event (the event described in the NRC) is dependent on the occurrence of the first one (the event in the antecedent of the conditional). In our example, Dr. Meier only can give Gert the antidote if Gert reaches him. But whether or not Dr. Meier has got the antidote available, is probably quite independent of Gert’s reaching him. This might favor an embedded interpretation in the event-condition, although the NRC is not structurally embedded.

To tease apart the options (i) and (ii) more neatly and rule out the worry in (iii), we set up a third experiment in which we focused exclusively on NRCs and explicitly disambiguated the rhetorical relations holding between NRC and the clause embedding it.

2.3.1. Design

In Experiment 3, with 41 participants, and a subset of 12 items out of the 18 of Experiment 1, we exclusively tested NRCs, again with event and state PREDICATE-type and manipulated the RHETORICAL relations holding between the NRC and its embedding clause by introducing explicit markers. We either introduced an explicit ”dann” (then), which should favor RESULT or NARRATION as rhetorical relation, or an explicit ”wider Erwarten” (against expectations), which should establish a CONTRAST-relation holding between NRC and the clause embedding it. Note that CONTRAST just as NARRATION and RESULT counts as a coordinating relation (Asher and Vieu, 2005). Unlike in NARRATION or RESULT, however, CONTRAST is not causal. Again, the four conditions were tested in a Latin square design, such that each of the 41 participants judged each condition three times but each item only in one condition.

(9) a. (event)
Wenn Gerd Dr. Meier erreicht, der ihm (dann/wider Erwarten) das Gegengift verabreicht, kann Gerd gerettet werden.
(If Gerd Dr. Meier reaches, who him (then/counter expectations) the antidote gives, can Gerd saved be.)

b. (state)
Wenn Gerd Dr. Meier erreicht, der (dann/wider Erwarten) über das Gegengift verfügt, kann Gerd gerettet werden. (If Gerd Dr. Meier reaches, who (then/counter expectations) the antidote has available, can Gerd saved be.)

2.3.2. Predictions:

If coordinating rhetorical relations are responsible for the embeddability of certain NRCs, all NRCs should be acceptable, since in all conditions a coordinating relation is forced (by inserting ”dann”/”then” and ”wider Erwarten”/”counter expectations”). If the embeddability is
limited to continuative relative clauses, only NRCs with event predicate are expected to be accepted (both with "dann" and "wider Erwarten"), whereas conditions with state predicates would be expected to be degraded (independently of the inserted particle), since according to Holler (2005) state-predicates block continuative readings. If causality plays a role, only NRCs with event-predicate and "dann" are expected to be acceptable, while "wider Erwarten" is expected to block embedding.

2.3.3. Results:

In Experiment 3, the results improved overall for all test-sentences independently of the predicate-type. The condition with event-predicate and "wider-Erwartern" was accepted in 82 percent of all trials, the condition with state-predicate and "dann" still reached 62 percent of acceptance judgements. In between these two conditions, the results display a clear down step pattern such that NRCs with "wider Erwarten" rated better than those with "dann" and within each rhetorical relation, just as in the previous experiments, sentences with event predicate rated better than those with state predicate.

Figure 3: Results Experiment 3

The statistical model confirmed these observations. Fitting a mixed model regression with the interaction of sentence-type and predicate-type as fixed effects and the corresponding random effects for items and participants, we found a significant effect of PREDICATE-type (p<0.05) as well as a significant effect of RHETORICAL RELATION (p<0.05), but no interaction between these two factors.\textsuperscript{8}

\textsuperscript{7}Compared to the acceptance rates reached in the first two experiments for test-sentences with NRC sentence-type

\textsuperscript{8}Generalized linear mixed model fit by the Laplace approximation, Formula: Answer ∼ Relation * Predicate + (1 + Relation + Predicate | Person) + (1 + Relation + Predicate | Item).
2.3.4. Discussion

The data confirm impressively that sentence-final NRCs in German can be interpreted as embedded. Moreover, they suggest that forcing a coordinating rhetorical relation seems to improve the embeddability.\(^9\) This holds even if the NRC is of state predicate type and even if the relation established between NRC and host-clause is not causal. We therefore assume that the embeddability is neither restricted to continuatives in the sense of Holler (2005) nor to NRCs that are causally dependent on the content of the antecedent.

3. Analysis

The findings confirm that NRCs are flexible in their scope and under certain conditions can contribute locally to the truth conditions of their host-clause (Schlenker, 2010). The availability of embedded readings, however, seems to be dependent both, on the position of the NRC Schlenker (2013) and on the rhetorical relation holding between the NRC and its host-clause (this paper). This challenges most of the existing approaches, which presume or predict that NRCs invariantly take widest scope (McCawley, 1982; Potts, 2005; Arnold, 2007; AnderBois et al., 2011). In the following, we will sketch very briefly how far we can go with very basic and traditional assumptions about NRCs to account for the observed scope pattern of NRCs. We will start from the following basic assumptions: (i) NRCs are attached low at DP-level (von Stechow, 1979). (ii) In situ (host-internal) NRCs are interpreted with widest scope. (iii) Extraposited (host-final) NRCs are flexible in scope. (iv) In the extraposed case, the type of rhetorical relation established between NRC and host-clause affects which sentential-node is considered as a suitable attachment point.

3.1. NRCs in situ

Let us assume that NRCs, just like their restrictive counterparts, are of type \(<e,t>\) and attached at DP-level to their head DP (von Stechow, 1979; Heim and Kratzer, 1998). To prevent the NRC from ending up invariantly in the scope of a sentential operator, such as a conditional, we assume that the NRC is attached to the DP by a tentative relation which, at this point in the derivation, is temporarily abstracted from \((\lambda R_{\text{t}})\), see figure 4 and rule (10).

\[
\text{(10) NRC Attachment Rule (in situ): If C is a branching node consisting of two sister nodes A and B, A with the translation } \alpha \text{ of type } ((et)t) \text{ and B with the translation } \beta \text{ of type } (et), \text{ C translates as: } \lambda R.\lambda P.R(\alpha(P))(\alpha(\beta))
\]

\(^9\) A further reason for the increase in acceptability might be that in Experiment 3, in contrast to the two previous experiments, we only tested NRCs and the design did not include a direct comparison with competing constructions such as and-conjunction or matrix-clause paraphrases.
Since this tentative relation cannot be resolved, it is projected, by standard compositional means (functional composition) up the tree. Notably, it is projected across the IP-node of the conditional antecedent.\footnote{Note that resolving the tentative relation by inserting the if in C would result in a crash of the derivation as soon as the consequent-clause is added.}

**Figure 4: NRC in situ**

![Diagram of NRC in situ](image)

At CP-level, the tentative relation still is unresolved and has to be instantiated pragmatically by establishing a suitable rhetorical relation.

\[(11) \quad \text{Denotation at CP-level:} \]
\[\lambda R.R((\text{reach}'(\text{Gert,Meier})) \rightarrow (\text{saved}'(\text{Gert}))) \]
\[(\text{have}_\text{antidote}'(\text{Meier}))\]

According to this analysis, in situ NRCs always project to matrix level. Note that this analysis makes no predictions about the discourse status of the NRC. Whether or not the NRC is at-
issue, for example, might depend on the position (Syrett and Koev, 2015) and the rhetorical relation (Jasinskaja, sion) holding between NRC and the sentence embedding it.

3.2. NRCs ex situ

Things change, if the NRC is extraposed. We assume that in this case, the NRC is moved from its DP-modifying position, where it leaves a trace $Q$ of type $et$, to the right edge of a clause (at any sentential level IP or CP), where the trace is bound.

![Figure 5: NRC ex situ](image-url)

\[
\begin{align*}
\lambda p. \lambda q. (p \rightarrow q) \\
\lambda q. (reach_{in\ time}'(Gert, Meier)) \land (have\_antidote'(Meier)) \rightarrow q
\end{align*}
\]
NRC Adjunction Rule (ex situ):
If C is a branching node consisting of two sister nodes A and B, A with the translation $\alpha$ being of type $(t(tt)((et)t))$ and B with the translation $\beta$ of type $(et)$, C translates as: $(\alpha)(\wedge)(\beta)$

To make an embedded reading available, we now only have to assume that in the case in which the NRC is extraposed and attached at the right edge of a clause, the missing connective can be instantiated by a conjunction, as spelled out by rule (12) and in figure 5 above. Granted, this analysis is not type-driven but requires some construction specific attachment rules for extraposed NRCs. If, however, we assume such additional rules, the differences between in situ and extraposed NRCs fall out quite neatly. While in situ NRCs are predicted to project to CP-level, extraposed NRCs can be attached to any sentential node to which they are right-adjacent and locally conjoined. Which of these potential attachment points are preferred might depend on pragmatic factors such as context information and the rhetorical relation holding between NRC and host-clause. Moreover, there might be a general preference for high-attachment sites even in case of extraposed NRCs, since in case of low attachment the NRC competes with corresponding and-conjunctions, which are not ambiguous.

3.3. Effect of rhetorical relations

In this subsection, we will sketch very briefly two possible explanations for why and how rhetorical relations might affect the choice between low and wide scope readings of NRCs. Comparing the projection patterns of NRCs, conventional implicatures and presuppositions, Simons et al. (2011) assume that (semantic) operators such as conditionals only target material that is "at-issue" in a given context, e.g. addresses the actual QUD (Roberts, 1996). A first explanation for the observed contrasts might be that NRCs with coordinating and subordinating relations differ in the way in which they contribute to the QUD addressed by the host-clause.\footnote{This in fact is roughly what Jasinskaja (sion) argues for in her paper on the (non-)at-issue status of (non-embedded) NRCs. She assumes that each discourse unit (also subsentential ones) addresses an issue on its own. In case of coordinating discourse relation the subsequent units can be combined to form a coordinated discourse topic (e.g. be coordinated to address an overarching QUD). In case of a subordinating discourse relation, however, the second unit introduces a subquestion of its own and does not contribute directly to the QUD addressed by the previous unit. If we combine the assumptions of Roberts (1996) and Jasinskaja (sion), we might get an explanation for the contrasts observed.}

(13) Wenn Gert Dr. Meier erreicht,
(If Gert Dr. Meier reaches)
a. der ihm das passende Gegengift verabreicht,
(who him the right antidote gives) (NARRATION)
b. der über das passende Gegengift verfügt,
(who the right antidote has) (EXPLANATION)
ist Gert gerettet. (is Gert saved.)

Let us assume that the QUD the main-clause addresses is the question If what happens can Gert be saved?\?. Intuitively, the in NRC (13a) provides part of the answer to the question addressed
by the host-clause and is interpreted locally. The NRC in (13b), by contrast, does not give an answer to this question but addresses an issue on its own, namely why Gert is saved as soon as he reaches Dr. Meier. Note, however, that the assumption that projectivity and non-at-issueness are generally related is not uncontroversial. Simons et al. (2011: 315) themselves discuss potential counterexamples to this claim.

(14) Q: Who’s coming to the dinner tonight?
   A: Well, I haven’t talked to Charles, who probably won’t be able to come,
      but I did talk to Sally, who is coming.

Although the NRCs in (14) address the QUD raised by the preceding question, they project. To explain the suitability of the NRCs in (14), Simons et al. (2011: 315) assume that NRCs are non-at-issue by default and, hence, can not address the QUD at all. The utterance of (14) is suitable only since the hearer is able to reconstruct a new QUD for the sentence, for example who A has talked to about the dinner. According to these assumptions, NRCs, are predicted to be always projective, since they are assumed to be inherently non-at-issue. This, however, is not what we found in our experiments.

Another aspect in which coordinating and subordinating discourse relations often differ, is that subordinating discourse relations in contrast to coordinating ones are in many cases speaker-oriented. For instance, EXPLANATION is a speaker-oriented relation whose second argument gives support to the first. This, however, means that the speaker must endorse both the explanation and the explanandum, which might explain, why NRCs expressing an EXPLANATION have a strong tendency to be interpreted with widest scope. The example in (15) (provided by Katja Jasinskaja p.c.) illustrates that speaker-orientedness indeed might play a role. In German the discourse connectives ”deshalb” and ”also” both force a coordinating translation. In contrast to ”deshalb”, ”also”, however, is speaker-oriented. ”A deshalb B” in German is equivalent to ”A, and therefore B”, while ”A also B” roughly translates as ”A, and therefore I believe B”. If in (15), the causal relation between Eva’s criticism and the Max’ anger is expressed by the non-speaker-oriented ”deshalb”, the NRC is interpreted locally as part of the conditional antecedent: ”if Eva criticizes Max and that makes him angry, ...”. By contrast, ”also” makes the utterance infelicitous because the causal antecedent of the speaker’s belief that Max is angry is not accessible in the global context. Similarly, in English, (6a) gets awkward if we mark speaker-orientedness as in (16).

(15) Wenn Eva Max kritisiert, der sich deshalb/??also ärgert, ...
    (If Eva Max criticizes, who refl therefore/hence is annoyed, ... )

(16) *If Peter called the Dean, who then (*frankly/*by the way/...) called the Chair, I would be in deep trouble.

As Katja Jasinskaja (p.c.) pointed out to me, asyndetically juxtaposed sentences have a strong tendency to be interpreted as expressing subordinating relations, typically EXPLANATION (Jasinskaja, 2007), while coordinating ones tend to be explicitly marked (cp. (17a) to (17b)).
NRCs, however, are asyndetic (17c). This might contribute to their preference for subordinating relations and high-attachment.

(17) a. Mary fired Bill. He drank too much. (EXPLANATION: drinking causes firing)
    b. Mary fired Bill. And he drank too much. (RESULT: firing causes drinking)
    c. Mary fired Bill, who drank too much. (EXPLANATION: drinking causes firing)

4. Conclusion

In this paper, we presented the results of three experiments, which show that, contrary to standard assumptions (McCawley, 1982; Potts, 2005; Arnold, 2007; AnderBois et al., 2011), embedded readings are available for NRCs in German. In contexts incompatible with a wide-scope interpretation, NRCs were significantly more often accepted as suitable than the corresponding parentheticals and postponed matrix clauses. This strongly confirms an assumption made by Schlenker (2013) that NRCs can have narrow scope interpretations in which they contribute conjunctively to the content of their host-clause. Moreover, the results suggest that the availability of such embedded readings is dependent on the predicate type of the NRC and the type of the rhetorical relation established between the NRC and its host-clause (coordinating vs. subordinating). NRCs of event-predicate type were interpreted significantly more often as embedded than those of state-predicate type. If, however, a coordinating relation was forced, by introducing coordinating discourse particles like “dann” (then) or “wider Erwarten” (counter expectations), the availability was increased independently of the predicate-type. We took this as a first piece of evidence for the assumption that the embeddability is neither restricted to continuatives in the sense of Holler (2005) nor to NRCs that are causally dependent on the content of the antecedent. Note, however, that we only tested the interpretation of NRCs that were located in clause-final (extraposed) position at the right edge of the antecedent of a conditional. Examples provided by Schlenker (2013) from English and French suggest that embedded readings are available with other (sentential) operators (such as “conceivable”), but only as long as the NRC is extraposed. To account for these observations, we suggested an analysis according to which in situ NRCs are forced to project, while extrapolated NRCs are flexible in their scope. The observation that rhetorical relations affect the scope of (extraposed) NRCs raises interesting puzzles for any analysis of NRCs and for our understanding of projection in general (Simons et al., 2011). To discuss these questions, however, goes beyond the scope of this paper and should be addressed by further research.

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Split-antecedent relative clauses and the symmetry of predicates
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Abstract. This paper presents the results of two experiments in German testing the acceptability of (non-)restrictive relative clauses (NRCs/RRCs) with split antecedents (SpAs). According to Moltmann (1992), SpAs are only grammatical if their parts occur within the conjuncts of a coordinate structure and if they have identical grammatical functions. Non-conjoined SpAs that form the subject and the object of a transitive verb are predicted to be ungrammatical. Our study shows that the acceptability of such examples improves significantly if the predicate that relates the parts of the SpA is symmetric. Moreover, it suggests that NRCs and RRCs behave differently in these cases with respect to the SpA-construal. We can make sense of this observation if we follow Winter (2016) in assuming that transitive symmetric predicates have to be analyzed as unary collective predicates and thus provide a collective antecedent for the RC at the semantic (not the syntactic) level. As we will argue, this accounts for some of the disagreement we found in the literature and gives us new insights into both the semantics of symmetric predicates and the semantics of NRCs.

Keywords: non-restrictive relative clause, restrictive relative clause, symmetric predicate, split antecedent.

1. Introduction

We speak of a split antecedent (SpA) of a relative clause when the antecedent is jointly expressed by distinct syntactic constituents in its host clause, as in (1). This constellation constitutes a challenge for the analysis of relative clauses.

(1) Mary met a man$_i$ and John met a woman$_j$ [who$_{i,j}$ knew each other well].

(Moltmann, 1992: 262)

Moltmann (1992) assumes that split antecedents are only possible if the antecedent phrases occur within the conjuncts of a coordinate structure and if they have identical grammatical functions, which is the case in (1). This generalization correctly excludes the sentence in (2a), where we find an overt conjunction, but the first antecedent phrase is the subject of the first conjunct, and the second antecedent phrase is the direct object of the second conjunct. The generalization also correctly excludes examples such as (2b), where an overt conjunction is

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missing, and the two antecedent phrases again have distinct grammatical functions.

(2) a. *A woman\textsubscript{i} came and John met a man\textsubscript{j} [who\textsubscript{i,j} knew each other well].
    b. *A man\textsubscript{i} saw a woman\textsubscript{j} [who\textsubscript{i,j} had danced together]. (Moltmann, 1992: 263)

However, we would, then, wrongly exclude (3), which is taken from Hoeksema (1986: 64). (3) is generally judged as acceptable, although, just as in (2b), an overt conjunction is missing, and the two parts of the split antecedent form the subject and the object of a transitive predicate.

(3) We always let those boys\textsubscript{i} play with those girls\textsubscript{j} [who\textsubscript{i,j} know one another from elementary school].

In this paper, we will explore the idea that one reason for the contrast between (2b) and (3) might be that, in the latter case, the two antecedents are related by a symmetric predicate. According to Winter (2016), transitive symmetric predicates have to be analyzed as unary collective predicates. This might favor an SpA-construal. We will present the results of two experiments in German investigating this effect of the symmetry of the matrix-clause predicate on the acceptability of restrictive and non-restrictive relative clauses with SpAs. Our findings will not only shed new light on the diverging judgments in the previous literature but also provide insights into both the semantics of symmetric predicates and SpA-relatives.

We will first present some basic assumptions on restrictive and non-restrictive relative clauses (RRCs/NRCs), see Section 2. In Section 3, we will present the relevant ideas on symmetric predicates from Winter (2016). We derive two empirical hypotheses from these two sections and present two questionnaire studies that we carried out to test them, see Section 4. In Section 5, we will sketch an analysis compatible with our empirical findings, before we end with a conclusion, see Section 6.

2. Antecedence construal with restrictive and non-restrictive relative clauses

In this section, we will summarize the relevant observations on the relation between RRCs and NRCs and their antecedents.\footnote{See Fabb (1990) and Huddleston and Pullum (2002: Chapter 7) for an overview of differences between RRCs and NRCs.}

RRCs are interpreted as predicates where the relative pronoun marks the variable that is abstracted over. The RRC is semantically integrated as a restriction on the denotation of a nominal projection that it attaches to (Heim and Kratzer, 1998). In non-split cases, the antecedent of an RRC is always a syntactic constituent. If we carried this over to the SpA-construal, we would expect that RRCs should be impossible with SpAs unless there is independent evidence for a syntactic constituent consisting of exactly the antecedents.

In her study of relative clause extraposition, Walker (2017) follows Keller (1995) in assuming that the link between an RRC and its antecedent is based on the “local” syntactic and semantic information of the antecedent constituent. “Local” properties include the syntactic category
(but not constituent structure information) and lexical semantic information (but not information on quantification or definiteness). This allows for cases like (4) from Walker (2017: 181).

(4) This list does not even include [the house and the car] [RRC: I want for my family].

In this example, the antecedent relation is established between the relevant semantic and syntactic properties of the conjunct the house and the car, which do not include the determiner semantics. What is important for us here is that even in such cases, there is a syntactic constituent acting as the antecedent of the RRC.

For NRCs, in contrast, it has been argued that the relative pronoun is equivalent in interpretation to a discourse-anaphoric pronoun (Sells, 1985; Del Gobbo, 2003; Holler, 2005; Schlenker, 2010). Indeed, NRCs often pattern quite consistently with their discourse-anaphoric matrix-clause paraphrases, compare a. and b. as well as c. and d. in (5).³

(5) a. *Every climber, who was French by the way, made it to the summit.
   b. Every climber made it to the summit. *He was French by the way.
   c. Most climbers, who were all French by the way, made it to the summit.
   d. Most climbers made it to the summit. They were all French by the way.

   (adapted from Nouwen 2007)

Arnold (2004, 2007) argues that the difference between the two types of relatives does not so much lie in their syntactic attachment — both attach to their respective antecedent — but rather in the semantics of their relative pronoun and, following from this, the antecedent construal and the semantic (non-)integration of the relative clause.

In some cases, however, relative pronouns of NRCs seem to be more restricted than their discourse-anaphoric counterparts. In particular, it can be assumed that an NRC, unlike a discourse-anaphoric pronoun, can only take a discourse referent as its antecedent if it is accessible in its host clause. The antecedent of a discourse pronoun can be introduced in a more ad hoc way — such as by “abstraction” in Kamp and Reyle (1993). In particular, so-called complement set anaphora (Moxey and Sanford, 1987; Nouwen, 2003) is possible with discourse-anaphoric pronouns but completely unavailable with NRCs. In (6a), the pronoun they can refer to the set of those children that did not eat their ice cream. Such an interpretation is not possible for the relative pronoun in (6b).

(6) Few of the children ate their ice cream, . . .
   a. they threw it around the room instead. (Moxey and Sanford, 1987: 192)
   b. *who, by the way, threw it around the room instead.

³Del Gobbo (2003) assumes that NRCs such as (5c) are ungrammatical if the NRC is clause-internal. Nouwen (2007), by contrast, argues that a clause-internal NRC is possible in structures like (5c) but, unlike discourse-anaphoric pronouns, can only take the set of climbers as its antecedent, not the subset of climbers who reached the summit. Cf. Poschmann (2013) for experiments on the interpretation and acceptability of such sentences in German.
Given this state of the theoretical discussion, we expected that NRCs with split antecedents should only be possible if we can find independent motivation for the existence of an appropriate plural antecedent in the interpretation of the matrix clause. We will see in the next section that exactly this is actually possible.

3. The symmetry of predicates

Symmetric predicates are such that there are two argument slots that can be interchanged without changing the truth conditions. This is sketched in (7a) for the verb quarrel. A non-symmetric predicate, as expressed by see, does not allow for such a truth-preserving change in the grammatical function, see (7b).

(7) a. Symmetric predicate: A quarrels with B. ⇔ B quarrels with A.
   b. Non-symmetric predicate: A sees B. ̸⇔ B sees A.

Many symmetric predicates allow for a use with a plural in one of the argument slots and a reciprocal pronoun in the other, (8a). In addition, this reciprocal pronoun need not be there, as shown in (8b).

(8) a. Reciprocal use: A and B quarrel with each other.
   b. Collective use: A and B quarrel.

These observations give rise to the following research questions: (i) Is the alternation between a binary use as in (7a) and a unary use as in (8b) productive and systematic? (ii) If so, does the collective use derive from the symmetry of the binary predicate, or does the existence of a binary realization follow from the collectivity of the unary predicate? (iii) Since the alternation has an argument-structural reflex that is semantically induced, the question is at which level of linguistic analysis the alternation will arise.

The answers to these questions are manifold. For example, Gleitman (1965) and Lakoff and Peters (1969) assume that a syntactic transformation links the binary and the unary use of symmetric predicates. They differ, however, in that Gleitman derives the unary use from the binary one, see (9a), whereas Lakoff & Peters do it the other way around, see (9b).

(9) a. John met Mary and Mary met John \(\Rightarrow\) John and Mary met.
   b. John and Mary met. \(\Rightarrow\) John met Mary.

Winter (2016) takes a very different approach. Instead of having a syntactic transformation

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\(^4\)In addition to the alternations in English, we find inherently-reflexive realizations of the binary predicate in German, which clearly have the collective rather than a reciprocal meaning. In (i), only the inherently-reflexive realization can be used, not the explicitly reciprocal. We will ignore this complication here and treat the inherently-reflexive realization just on par with a collective realization, which seems to be adequate – at least semantically.

(i) Alex und Chris streiten (sich/ *einander) immer.
    Alex and Chris quarrel themselves/ each other always
    ‘Alex and Chris always have a fight.’
between a binary and a unary use of a verb, he postulates an underlying protopredicate and derives the concrete binary and unary predicates from the denotation of the protopredicate.

The denotation of a protopredicate contains all instances compatible with a particular natural-language expression. Winter discusses the example of the verb hug: Some huggings are collective, which means that a protopredicate hug will have group objects consisting of collectively hugging people in its denotation. Other huggings are directional, i.e. there is one person hugging and another person being hugged. For these cases, the denotation of hug will also contain pairs whose first element is the hugger and whose second the ‘huggee’.

Winter (2016) does not use protopredicates directly in sentences. One reason for this is probably that the denotation of a protopredicate may contain both single objects and tuples, whereas predicates in a sentence have a fixed arity. Looking at Winter:16 analysis, there might be a second reason: the structure of the elements in the denotation of the protopredicate is clearly connected to a contentful interpretation of semantic (proto-)roles (in the sense of Dowty 1991). The semantic argument slots in a concrete predicate need not have such a clear-cut interpretation. In particular, Winter (2016) assumes that different argument slots of concrete predicates can bear the same semantic role, whereas this would not be possible for the argument slots in the denotation of a protopredicate.

Winter (2016) defines three mappings from protopredicates to concrete predicates. For the protopredicate hug, for example, there is a binary non-symmetric predicate hug\textsubscript{bns} and a unary collective predicate hug\textsubscript{uc}. The denotation of hug\textsubscript{bns} is the subset of the denotation of hug that contains all hugger-hugged pairs. The denotation of hug\textsubscript{uc} is the subset of the denotation of hug that consist of all hugging-sets. Winter also provides a binary symmetric predicate, hug\textsubscript{bs}. The denotation of this predicate is such that for each of the collective huggers \(x \oplus y\), it contains the pairs \((x,y)\) and \((y,x)\).

This system directly accounts for the fact that the binary symmetric use of a predicate is synonymous to its unary collective use, even though the argument frame is different. At the same time, it captures the fact that a binary non-symmetric and a binary symmetric use are non-synonymous even though they have the same number of syntactic arguments.

The verb quarrel expresses an inherently-collective concept. Therefore, the protopredicate quarrel only contains plural objects and no pairs. Consequently, there can be a unary collective predicate quarrel\textsubscript{uc} and a binary symmetric predicate quarrel\textsubscript{bs}, but the corresponding binary non-symmetric predicate is not defined. Similarly, for a non-symmetric protopredicate, there

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5Winter (2016) uses a set notation for the collective objects, \(\{x, y\}\). We will use the notation \(x \oplus y\) here, which makes it clearer that we are dealing with a single entity – in contrast to a tuple of entities, \((x, y)\), needed for the non-collective denotations.

6Note that symmetric readings are available even if the set consists of more than two members. In this case the symmetric reading (ia) is clearly more expressive than the reciprocal binary paraphrases in (ib). Winter (2016) takes this as evidence for his assumption that collective predicates are basic and irreducible to their binary forms.

(i) a. A, B and C are similar.
   b. \(\neq\) A is similar to B, B is similar to C, C is similar to A.
will be no corresponding unary collective predicate nor a binary symmetric predicate.\footnote{Though, of course, there can be a non-empty reciprocal subset of the denotation of the protopredicate, i.e. all cases where both \(\langle x, y \rangle\) and \(\langle y, x \rangle\) occur in the denotation of the protopredicate.}

What does this mean for the possibilities of antecedent construals with relative clauses? In the case of a unary collective predicate, there is both a syntactic and a semantic unit that can serve as an antecedent for a relative clause. For a binary non-symmetric predicate, there is neither a syntactic nor a semantic unit, so no antecedent construal should be possible for any type of relative clause. The same is true, in fact, for a binary symmetric predicate: since its denotation is a set of pairs, it is ontologically indistinguishable from a binary non-symmetric predicate.

If, however, we have access to the protopredicate in addition to the concrete predicate, a possible semantic antecedent would be available in sentences with a binary symmetric predicate (and, trivially, for the unary collective predicate). Since this collective argument is not part of the syntactic structure, the antecedent-construal process can only be semantic, not syntactic. We thus expected it to be possible for NRCs but not for RRCs.

To sum up, none of the analyses of symmetric predicates would predict the acceptability of an SpA-construal for RRCs. For NRCs, the picture is slightly different: a syntactic approach à la Lakoff and Peters (1969) assumes the required plural antecedent provided that the underlying syntactic structure can be used for relative clause attachment. Similarly, the semantic analysis in Winter (2016), as it stands, does not seem to predict SpAs for NRCs. However, if we can include the protopredicate in the interpretation, an NRC would be possible, though an RRC would still be excluded.

We have carried out two questionnaire studies to get a clearer picture of the empirical facts and to see which of the approaches to antecedent construal and symmetric predicates can best account for them.

4. Experiments

In this section, we will report the results of two experiments in German that suggest that the symmetry of a binary predicate relating the parts of a split antecedent can indeed affect the acceptability of the SpA-relative clause. Moreover, we will show that RRCs and NRCs behave differently with respect to SpA-construal. Both experiments were conducted as pen-and-paper questionnaires with first-semester students in Frankfurt a.M., Germany.

4.1. Experiment 1

In a first questionnaire, with 39 participants, we tested the acceptability of non-conjoined SpAs depending on the T\textsc{ype} of the relative clause (RRC vs. NRC) and the S\textsc{ymmetry} (±symmetric) of the matrix-clause predicate relating the heads of the SpA.
4.1.1. Design

All items were constructed such that there was a plural-RC in sentence-final position and a matrix clause with definite DPs as antecedents for the SpA with one antecedent-DP forming the subject and the other the object of a transitive matrix-clause predicate. The relative clause was either an RRC or an NRC and the matrix-clause predicate either symmetric or non-symmetric. Overall, we tested 12 items in 4 conditions (NRC/RRC*±Symmetry) distributed over a Latin-square design, such that every participant judged every condition three times but each item only in one condition. An example for a test item in all four conditions is given in (10).

\[(10)\]

\begin{enumerate}
\item Letzte Woche hat sich mein Hausarzt mit meinem Heilpraktiker \textit{gestritten}, die einander sonst übrigens sehr schätzen.
  \begin{quote}
  ‘Last week, my doctor quarreled with my non-medical practitioner, who by the way normally appreciate each other.’
  \end{quote}
  \text{(NRC/+SYMM)}
\item Letzte Woche hat mein Hausarzt meinen Heilpraktiker \textit{beleidigt}, die einander sonst übrigens sehr schätzen.
  \begin{quote}
  ‘Last week, my doctor insulted my non-medical practitioner, …’
  \end{quote}
  \text{(NRC/-SYMM)}
\item Letzte Woche hat sich derjenige Hausarzt mit demjenigen Heilpraktiker \textit{gestritten}, die einander sonst sehr schätzen.
  \begin{quote}
  ‘Last week, precisely that doctor quarreled with precisely that non-medical practitioner who normally appreciate each other.’
  \end{quote}
  \text{(RRC/+SYMM)}
\item Letzte Woche hat derjenige Hausarzt denjenigen Heilpraktiker \textit{beleidigt}, die einander sonst sehr schätzen.
  \begin{quote}
  ‘Last week, precisely that doctor insulted precisely that non-medical practitioner …’
  \end{quote}
  \text{(RRC/-SYMM)}
\end{enumerate}

Non-restrictive interpretations were forced by adding a discourse particle, typically übrigens ‘by the way’, inside the relative, which should rule out a restrictive interpretation. In the RRC-conditions, these particles were omitted, instead the heads of the relative included the determiner \textit{derjenige} ‘precisely that’, which should rule out a non-restrictive interpretation.

Since in German, the plural form of the relative pronoun is syncretic with its feminine singular form \textit{die}, we designed all test items with exclusively singular masculine subjects and objects. This ensured that the RC was not interpreted solely with respect to one of its antecedents. In all conditions, the RC was extrapolosed across the clause-final matrix predicate. Unlike in English (Rochemont and Culicover, 1990; Walker, 2017), extrapolosition from a definite DP is generally

\footnote{List of predicates used in the symmetric condition: \textit{sich streiten mit} ‘to quarrel with s.o.’, \textit{telefonieren mit} ‘to talk with s.o. on the phone’, \textit{sich schlagen mit} ‘to fight with s.o.’, \textit{diskutieren mit} ‘to debate with s.o.’, \textit{sich zusammentun mit} ‘to team up with s.o.’, \textit{übereinstimmen mit} ‘to come to an agreement with s.o.’, \textit{sich beratschlagen mit} ‘to consult with s.o.’, \textit{zusammenarbeiten mit} ‘to collaborate with s.o.’, \textit{aussehen wie} ‘to look like s.o.’, \textit{sich vertragen mit} ‘to make up with s.o.’, \textit{sich unterhalten mit} ‘to talk with s.o.’, \textit{sich treffen mit} ‘to meet with s.o.’}

\footnote{Note that in German, unlike in English, both RRCs and NRCs are obligatorily separated by a comma.}

\footnote{A relative clause attached to a \textit{derjenige}-head cannot contain discourse particles:}

\begin{enumerate}
\item Derjenige Heilpraktiker, der (*übrigens) Peter beleidigt hat, ist meinem Hausarzt gut bekannt.
  \begin{quote}
  ‘Precisely that practitioner, who by the way insulted Peter, is well-known to my doctor.’
  \end{quote}
\end{enumerate}
judged as acceptable in German (Holler, 2005; Poschmann and Wagner, 2016), at least across minimal distances (1 word). To keep the distance between the split antecedents and the RC minimal, all test items of Experiment 1 were constructed such that the sentence-initial position (Vorfeld/prefield) of the matrix clause was occupied by a PP or a temporal or locational adverb, while the subject- and object-DPs were located adjacent to each other in the middle field of the matrix clause.

The test items were tested interspersed with 14 fillers, which included 7 examples of clearly acceptable and 7 clearly unacceptable examples of NRCs or RRCs, all without an SpA-construal.

4.1.2. Predictions

The RCs in Experiment 1 are all plural and hence looking for a plural antecedent in the matrix clause to which they can be attached. The matrix clause, however, does not provide such a plural antecedent, at least not at the syntactic level. Both the subject- and the object-DP are singular. Thus, from a syntactic point of view, the matrix clause does not provide a proper antecedent to which the RC can be attached.

**Hypothesis I:** $+\text{SYM} > -\text{SYM}$.

The semantic analysis of binary symmetric predicates could be such that the analysis of a sentence of the form *A quarrels with B* contains a unary collective predicate, *A and B quarrel*, as part of its interpretation. If this hypothesis is on the right track, one might expect that the acceptability of SpA-RCs improves if the parts of the split antecedent are connected by a symmetric predicate, since in this case the symmetric predicate provides a collective antecedent at the semantic level with respect to which the plural-RC can be interpreted. Non-symmetric predicates, by contrast, do not provide such a collective antecedent and should be judged as unacceptable.

**Hypothesis II:** NRC > RRC

If symmetric predicates provide a collective antecedent, they do so only at the semantic, not the syntactic level. If at all, an effect of symmetry would be expected to show up only in case of NRCs. According to standard assumptions, NRCs are linked to their head-DP only anaphorically – e.g. McCawley (1981); Sells (1985); Holler (2005); Arnold (2007) – and hence might not need a single syntactic antecedent. RRCs, by contrast, are non-anaphoric and seem to need a proper syntactic antecedent to which they can be attached. We hence expected to find an interaction of RC-TYPE and SYMMETRY, such that SYMMETRY only improves the acceptability of NRCs with SpAs but not the acceptability of RRCs with SpAs.

4.1.3. Results

The data reported for Experiment 1 are based on the judgments of 36 out of the 39 tested participants. We had to exclude 3 participants because they rated more than 4 of the 9 negative
fillers as good ($\geq 3$). The overall results of the experiment are summarized in Figure 1 for the test conditions and in Figure 2 for the filler conditions.

The results confirm that both RC-TYPE and SYMMETRY affect the acceptability of SpA-RCs. As expected, NRCs rated better than RRCs. For both types, SYMMETRY of the matrix predicate significantly improved the acceptability of the SpA-construal. The ratings show a clear downstep pattern. NRCs with a symmetric matrix predicate are rated as more or less acceptable (3.5 on a scale from 0 to 5), lower than the positive controls (4.3) but significantly higher than NRCs with a non-symmetric matrix predicate (2.9). RRCs with a symmetric matrix predicate got marginal acceptance rates (2.5), and RRCs with a non-symmetric matrix predicate rated nearly as low (2.1) as the negative controls (1.9).

Using the lme4 package in R, we fitted a model of mixed logistic regression for the interaction of RC-TYPE and SYMMETRY as fixed effects and random effects for subjects and items including the corresponding slopes (Formula: Rating $\sim$ Typ*Sym + (1+Typ*Sym | Person) +
Contrary to our expectations, however, the interaction between RC-TYPE and SYMMETRY did not turn out to be significant in our data. SYMMETRY equally affected the acceptability of NRCs and RRCs.

4.2. Experiment 2

Unlike predicted by Moltmann (1992), the results of Experiment 1 show that SpA-RCs with symmetric matrix predicate are acceptable in German, even if the parts of the split antecedent are not overtly conjoined. One possible explanation for the acceptability of the tested non-conjoined SpA-examples might be that the subject- and object-DP that formed the two parts of the antecedent stood adjacent to each other. This could have invited repair effects in which the participants treated the two antecedents as jointly forming a syntactic constituent. To rule out this possibility, we designed a second questionnaire, in which we tested whether the position of the two parts of the split antecedents with respect to each other affected the acceptability of the SpA-construal.

4.2.1. Design

In this second Experiment, with 45 different participants, we tested the 12 items of Experiment 1 with symmetric predicates only. We manipulated the RC-TYPE and, in addition, the WORD ORDER of the matrix clause, such that in one condition both head-DPs of the relative stood adjacent (+ADJACENCY) in the middle field of the clause, as in (10), whereas in a second condition, one of the antecedents occurred in the prefield and was, thus, separated from the other antecedent by an auxiliary in V2 position. In (11), we provide an example for a test item in all four conditions. As in Experiment 1, the test items were tested in comparison to 7 positive and 7 negative control items.

(11) a. **Mein Hausarzt** hat sich mit meinem Heilpraktiker gestritten, die einander sonst übrigens sehr schätzen.
   ‘My doctor quarreled with my non-medical practitioner, who by the way normally appreciate each other.’
   (NRC/-ADJACENCY)

   b. Letzte Woche hat sich **mein Hausarzt mit meinem Heilpraktiker** gestritten, die einander sonst übrigens sehr schätzen.
   ‘Last week, my doctor quarreled with my non-medical practitioner, who by the way normally appreciate each other.’
   (NRC/+ADJACENCY)

11According to Baayen et al. (2008), we can be confident that the comparison is significant if the absolute value of the t-value is bigger than 2 (or: 1.96).
c. Derjenige Hausarzt hat sich mit demjenigen Heilpraktiker gestritten, die einander sonst sehr schätzen.
   ‘Precisely that doctor quarreled with precisely that non-medical practitioner who normally appreciate each other.’ (RRC/-ADJACENCY)

d. Letzte Woche hat sich derjenige Hausarzt mit demjenigen Heilpraktiker gestritten, die einander sonst sehr schätzen.
   ‘Last week, precisely that doctor quarreled with precisely that non-medical practitioner who normally appreciate each other.’ (RRC/+ADJACENCY)

4.2.2. Predictions

**Hypothesis III: +ADJACENT > −ADJACENT**

If SpA-RCs are only acceptable if the parts of the antecedent are adjacent to each other, the acceptability of the examples should decrease if subject- and object-DP are separated by the finite verb.

4.2.3. Results

Overall, the ratings for NRCs and RRCs in Experiment 2 were comparable to those of the symmetric conditions in the first experiment, see Figure 3. Again, NRCs with SpAs rated as more or less acceptable (2.9 on a scale from 0 to 5), less than the positive controls (3.6) but significantly better than the RRCs (2.5) and the negative controls (2.5). The means suggest a slight downstep pattern, such that NRCs with adjacent antecedents rated slightly better (3.0) than NRCs with non-adjacent antecedents (2.8). RRCs with adjacent heads were judged a bit more acceptable (2.9) than RRCs in which the two parts of the antecedent were separated by the matrix-clause verb (2.4). However, this downstep was not significant in our data.

Fitting a mixed model regression for the interaction RC-TYPE and WORD ORDER and the corresponding random effects and slopes of items and participants (Formula: Rating ∼ Type*WO + (1+Type*WO | Person) + (1+Type*WO | Item)), we did find a significant effect of RC-TYPE (t = −2.441) but no effect of WORD ORDER (t = 1.681) and no significant interaction between RC-TYPE and WORD ORDER (t = 0.428).
4.3. Discussion

Our results clearly show that a split antecedent is acceptable for NRCs when the antecedent-DPs are co-arguments of a binary symmetric predicate. We saw in Section 3 that none of the presented approaches would make this prediction directly but that it is possible to mildly twist the account of Winter (2016) to make it fit. All we need to do is to make the protopredicate available in the interpretation of the matrix clause. As a result, a standard semantic-antecedent construal could be used for NRCs, given that the NRC attachment potential of binary symmetric predicates like A quarrels with B would be the same as that of unary collective predicates such as A and B quarrel. A similar construal is not possible for non-symmetric predicates, where neither the concrete predicate nor its protopredicate provides a collective antecedent.

The judgments for RRCs in our data were altogether rather marginal and significantly lower than those for NRCs. This indicates, as expected, that RRCs cannot find a regular antecedent in the SpA-constellations. It is, however, surprising that there is an effect of symmetry also for RRCs. This might point to the availability of a repair strategy for such sentences. We will come back to this in Section 5.
Another somewhat unexpected result of our experiment is that NRCs with non-symmetric predicates are rated considerably better than RRCs with non-symmetric predicates. We argued above that the antecedent construal of an NRC is a semantic rather than syntactic process, but there is no semantic antecedent available for the NRC in these cases. For cross-sentential discourse pronouns, antecedent construal is possible in such constellations, as illustrated in (12). We take it that the judgments in our study indicate that the participants were able to apply such a discourse-anaphora construal process as a repair strategy in these cases.

(12) Letzte Woche hat mein Hausarzt meinen Heilpraktiker beleidigt. Sonst schätzen sie einander sehr.
   ‘Last week, my doctor insulted my non-medical practitioner. Normally, they appreciate each other very much.’

The results of Experiment 2 confirmed the contrast between NRCs and RRCs. At the same time, it showed that the relative position of the two antecedent phrases in the sentence does not have any influence. This strengthens the position that an NRC finds its antecedent through semantic rather than syntactic properties. Similarly, the repair strategy speculated about for RRCs with symmetric predicates should be semantic rather than syntactic.

In the next section, we will go through the observations made in this discussion and show how we can integrate them into a concrete approach to symmetric predicates and antecedent construal for relative clauses.

5. Analysis

In this section, we will first develop a version of Winter:16 theory that allows us to account for our empirical findings directly. Then we will go through the four patterns tested in Experiment 1 in the light of our revised approach to symmetric predicates and our assumption on relative clauses from Section 2.

In our discussion of the experimental results in Section 4.3, we mentioned that we need to stipulate the simultaneous presence of the protopredicate *quarrel* and the binary symmetric predicate to account for the well-formedness of SpAs with NRCs and symmetric verbs. Our account of the data would, of course, be much smoother if we only had a single predicate.

We showed in Section 3 that the process to create the binary symmetric predicate is different in quality from the simple subdenotation formation for the other predicates. Instead, it splits plural objects into pairs. If we are, however, not bound to the assumption that a semantic predicate needs to reflect the syntactic properties, we are free to have a verb with more than one syntactic argument and interpret it as the unary collective predicate $quarrel^{uc}$. The resulting lexical entry is sketched in (13).\footnote{We assume a version of a dynamic, DRT-style, semantic framework. ‘$[x]$’ is used for the introduction of a new discourse referent, $x$. We use the colon, ‘;’, for dynamic conjunction. Superscripts in the examples indicate the introduction of a new discourse referent, subscripts the use of an already present discourse referent.}
Lexical entry of the binary symmetric verb *quarrel*:

a. semantics: \( \lambda y \lambda x. [X]; (X = x \oplus y); (\text{quarrel}^{uc}(X)) \)

b. subject: NP

c. complement: *with*-PP

We can, now, use this version of Winter:16 theory to go through the four patterns tested in Experiment 1. A simple version of the pattern in example (10a) is given in (14), together with an analysis that makes use of a lexical specification of a binary symmetric verb as in (13). The main clause introduces three discourse referents: the proper names each introduce one, \( a \) (Alex) and \( c \) (Chris), and the binary symmetric predicate introduces the group discourse referent \( X \) to overcome the difference in number between its syntactic and its semantic arguments – just as indicated in its lexical entry in (13).

When the NRC is attached, its relative pronoun introduces a new discourse referent, \( Y \), that needs to be bound to an already existing discourse referent. Since there is a plural discourse referent, \( X \), accessible, the antecedent construal can proceed as usual.

This analysis not only simplifies the analysis of symmetric predicates from Winter (2016) in eliminating the need for the formation of binary symmetric predicates, it also directly introduces the plural object \( X \) that can serve as the antecedent for an NRC.

In (15), we provide an example with a non-symmetric predicate and an NRC – just as (10b) above. The translation of the main clause is given in (15a). When the NRC is translated, as in (15b), there is no appropriate plural antecedent available to bind \( Y \) to.

Participants who do not fully reject examples of this type might be able to backtrack and to create an appropriate plural antecedent on the fly. This will allow them to combine the two introduced discourse referents \( a \) and \( c \) into a group referent \( X \). The corresponding parts to be inserted would look as in (16).

Let us now turn to the situation with RRCs. We will start with an example with a conjoined antecedent, where the possibility of attaching an RRC is uncontested. We will, then, use the
binary symmetric version of this example and show that the ordinary RRC-interpretation mechanism does not work. Finally, we will speculate on a possible repair strategy.

A relevant example is given in (17). The conjunction is formed by the introduction of a new discourse referent, \( X \), which consists of the referents \( x \) and \( y \). The mechanism for RRC-attachment in Walker (2017) ensures that the relative pronoun is interpreted as the main discourse referent of the antecedent and that the entire RRC is integrated in such a way that it imposes a further restriction on this discourse referent.\(^{13}\) The interpretation would be just the same if the RRC were extraposed.

\[
\begin{align*}
\text{(17)} & \quad \text{Heute haben sich \([\text{diejenige}^x \text{Katze und derjenige}^y \text{Hund}]^X\), die}_X \text{gestern so heftig gestritten haben, wieder vertragen.} \\
& \quad \text{‘Precisely that cat and precisely that dog who had quarreled fiercely yesterday got along again today.’} \\
& \quad \text{a. Conjunction (including the RRC):} \\
& \quad \quad [x]; \text{cat}(x); [y]; \text{dog}(y); [X]; (X = x \oplus y); \text{quarrel}^{uc}(X); \\
& \quad \quad \quad \quad + \text{uniqueness of the referent satisfying the conditions on } X \text{ up to now} \\
& \quad \text{b. Main-clause VP: get-along}^{uc}(X)
\end{align*}
\]

In (18), we give the binary version of example (17). In this case, extraposition is the only possibility. Contrary to what happens in the unary case, it is now the binary symmetric predicate \( \text{sich vertragen} \) ‘get along’ that introduces the plural discourse referent \( X \), not a nominal constituent. The relative clause, however, needs a nominal antecedent.

\[
\begin{align*}
\text{(18)} & \quad ?*\text{Heute hat sich \[\text{diejenige}^x \text{Katze mit demjenigen}^y \text{Hund wieder vertragen}^X\), die}_X \text{gestern so heftig gestritten haben.} \\
& \quad \text{‘Today precisely that cat got along with precisely that dog again who had quarreled fiercely yesterday.’} \\
& \quad \text{a. Main clause:} [x]; \text{cat}(x); [y]; \text{dog}(y); [X]; (X = x \oplus y); \text{get-along}^{uc}(X); \\
& \quad \quad \quad \quad \quad \text{+ uniqueness on } x \text{ and } y \\
& \quad \text{b. RRC: quarrel}^{uc}(X)
\end{align*}
\]

What could a repair mechanism look like that will mitigate the unacceptability of (18) but not of analogous examples with non-symmetric predicates? Given the presence of a plural discourse referent, there is at least the semantic half of what an RRC needs for its attachment, with only the syntactic part missing. Consequently, we might assume that some participants in our study added the missing syntactic information on the fly, which would, then, allow them to construct the same semantic representation as for (17).

\(^{13}\text{We only provide the existential component of the definite subject and gloss over the uniqueness condition.}\)
6. Conclusions

Our study confirms that SpAs are possible at least with NRCs and shows that the symmetry of the matrix predicate can remedy examples in which the two antecedents of an SpA are neither overtly conjoined nor have identical grammatical functions.\(^{14}\) This accounts for some disagreement we find in the literature and gives us new insights into both the semantics of symmetric predicates and the semantics of NRCs.

Concerning the first point, we could show that our data motivate a simplification of the theory of symmetric predicates developed in Winter (2016), where we could eliminate the mapping from protopredicates to binary symmetric predicates. Note that Winter:16 candidate for a universal, given in (19), can still be maintained in our system.

(19) **Symmetry as collectivity:** All symmetric binary predicates, in all natural languages, are derived from collective concepts through c-type protopredicates and the symmetric-binary strategy. (Winter, 2016: 30)

In our system, we assume the same protopredicates as Winter (2016) but only the formation of unary collective and binary non-symmetric ordinary predicates. It is, of course, more transparent to realize these predicates in such a way that the number of syntactic arguments matches the number of semantic participants. This 1-to-1 mapping is violated for binary symmetric verbs. Consequently, Winter:16 observation that unary collective predicates are primary to binary symmetric predicates is fully incorporated in our analysis.

As for the analyses of NRCs, our study provided new evidence that the antecedent of an NRC needs to be a discourse referent that is introduced within the clause hosting the NRC. This discourse referent need not be explicitly linked to a syntactic constituent, though it is not sufficient to be able to create such an antecedent by some general discourse process. Our data also support a combination of semantic and syntactic factors for RRC-attachment. This double requirement is responsible for the unavailability of SpAs with RRCs.

The careful reader will have noticed that the original well-formed examples of SpA-construal from Moltmann (1992) and her generalizations from them involved the coordination of sentences. Clearly, our paper did not say anything about such cases; we explained the contrast between (2b) and (3) but did not say anything about the contrast between (1) and (2a). Our analysis suggests that there needs to be an appropriate plural discourse referent introduced in the coordination for (1) to be grammatical and that such a discourse referent is absent in (2a).

A natural speculation would be that the subjects of the coordinated clauses in (1) form a joint discourse function. Rooth (1992: 91) explicitly connects his analysis of contrastive focus to the phenomenon of split antecedents with plural discourse anaphora, introducing an appropri-

\(^{14}\)Stockwell (2017) reports similar effects of symmetry on the acceptability of participant mismatch VP ellipsis.

(i)  
   a. John\(_1\) met with Mary\(_2\), even though she\(_2\) didn’t want to (meet him\(_1\)).
   b. *John\(_1\) criticised Mary\(_2\), even though she\(_2\) wasn’t supposed to (criticise him\(_1\)).
ate joint discourse referent in the interpretation of a sentence with two foci. It is plausible to assume the formation of discourse referents for other discourse functions as well. Moltmann’s observations on SpAs seem to pattern with complex topics as in (20). The question in (20) marks Alex and Chris as jointly bearing the discourse function topic. In (20a) and (20b), the two re-appear in different clauses but with the same grammatical function, which is a fully acceptable answer to the question. In (20c), the two elements of the topic have distinct grammatical functions, which blocks the association with the same discourse function.

(20) Wie kommen Alex und Chris heute nach Hause?
   ‘How will Alex and Chris get home today?’
   a. ALEX läuft und CHRIS fährt mit der U-Bahn.
      ‘Alex will walk and Chris will take the subway.’
   b. Jo bringt ALEX nach Hause und Kim fährt CHRIS heim.
      Jo will walk Alex home and Kim will give Chris a ride.’
   c. ?*ALEX läuft und Kim fährt CHRIS heim.
      ‘Alex will walk and Kim will give Chris a ride.

If this speculation goes in the right direction, Moltmann’s generalization would be reducible to general processes of the creation of discourse functions across coordination in combination with our generalization for the antecedent construal for NRCs.¹⁵

References


¹⁵An initial look at a wider range of data suggests that having a joint discourse function is more important than having the same grammatical function. In (iia), the two antecedents constitute a joint discourse function but bear different grammatical functions. In the less acceptable (iib), both are subjects but differ in their discourse status.

(i) Wer fällt dir grad im Bus auf? ‘Who are you noticing in the bus right now?’
   a. Vorn sitzt KIM und hinten sehe ich ALEX, die sich zum verwechseln ähnlich sehen.
      ‘Kim is sitting in the front and I spot Alex in the back, who resemble each other a lot.’
   b. ?*Vorn sitzt KIM und hinten sieht mich ALEX, die sich zum verwechseln ähnlich sehen.
      ‘Kim is sitting in the front and Alex spots me, . . .


Responsive predicates are question-embedding: Evidence from Estonian
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Abstract. The proper semantic treatment of the complements of Responsive Predicates (ResPs), those predicates which may embed either declarative or interrogative clauses, is a long-standing puzzle, given standard assumptions about complement selection. In order to avoid positing systematic polysemy for ResPs, typical treatments of ResP complements treat their arguments either as uniformly declarative-like (propositional) or interrogative-like (question). I shed new light on this question with novel data from Estonian, in which there are verbs think-like meanings with declarative complements and wonder-like meanings with interrogative complements. I argue that these verbs’ meaning is fundamentally incompatible with a proposition-taking semantics for ResPs, and therefore a question-taking semantics is to be preferred.

Keywords: responsive predicates, embedded clauses, interrogatives, contemplation, Estonian.

1. Introduction

It is well-established that clausal-selecting predicates differ in the types of complements they permit. Rogative predicates (terminology after Lahiri 2002) like wonder and ask only permit interrogative complements, anti-rogative predicates like think and believe only permit declarative complements, and responsive predicates (ResPs) like know and say permit either type of complement. The three predicate classes are exemplified in (1).

(1) a. Prudence thinks/believes \{that/why\} wombats are herbivores. \textit{Anti-rogative}  
b. Prudence wonders/asks \{*that/why\} wombats are herbivores. \textit{Rogative}  
c. Prudence knows/says \{that/why\} wombats are herbivores. \textit{Responsive}

Clausal arguments are argued in large part to be s(emantically)-selected (Grimshaw, 1979; Pesetsky, 1982, 1991)—that is, a clause-taking predicate lexically imposes a requirement that its complement be of a particular semantic type. ResPs pose a problem for this view given the widely-held assumption that declarative clauses denote propositions and interrogative clauses denote sets of propositions. Unless ResPs are systematically polysemous, there is no simple way for it to embed these two different types of arguments—and if they are systematically polysemous, it remains to be seen why that should be the case.

One indication we may not want to stipulate the selectional behavior of such verbs directly into the lexicon as opposed to deriving their selectional restrictions from independent properties of their semantics is that this tripartite categorization is also attested cross-linguistically. For

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instance, in Estonian, just as in English, there are indeed clausal-embedding verbs of all three selectional categories:

\[(2) \quad \begin{align*}
\text{a.} & \quad \text{Kirsi usub,} \quad \{\text{et}/*\text{miks}\} \text{ lapsed on aias.} \\
& \quad \text{Kirsi believes that/why the children are in the garden.} \\
& \quad \text{NESS} \\
& \quad \text{‘Kirsi believes that/why the children are in the garden.’} & \text{Anti-rogative} \\
\text{b.} & \quad \text{Kirsi küsib,} \quad \{\text{et}/\text{miks}\} \text{ lapsed on aias.} \\
& \quad \text{‘Kirsi asks *that/why the children are in the garden.’} & \text{Rogative} \\
\text{c.} & \quad \text{Kirsi teab,} \quad \{\text{et}/\text{miks}\} \text{ lapsed on aias.} \\
& \quad \text{‘Kirsi knows that/why the children are in the garden.’} & \text{Responsive}
\end{align*}\]

Indeed, far from being a quirk of English, the differential selectional behavior of clausal-embedding predicates is observed in many languages: therefore, to the extent possible, a general solution is preferable. But how can we reconcile our assumptions about selection with the existence of responsive verbs like *know*?

### 1.1 Prior solutions to the ResP puzzle

The dominant approach to solving the ResP puzzle is to reduce all clausal complements of ResPs to the same type. One flavor of this tactic is the *proposition-embedding* account of ResPs, in which the meaning of interrogative complements is reduced to a proposition, which are taken to be the denotation of declarative clauses (Karttunen, 1977; Groenendijk and Stokhof, 1984; Heim, 1994; Dayal, 1996; Lahiri, 2002; Egré, 2008; Spector and Egré, 2015; Mayr, 2017: a.o.). While this approach captures the behavior of responsive predicates, the existence of anti-rogatives becomes mysterious, since it will be necessary to justify the exclusion of type-shifted interrogative complements on independent grounds.

The mirror-image approach is the *question-embedding* account, which reduces the meaning of a declarative clause to a question, a position articulated most completely by Uegaki (2016) (though see also Elliott et al., 2017). Uegaki’s primary motivation for this approach comes from contrasts between anti-rogatives and ResPs with regards to their entailment patterns with content DP complements:

\[(3) \quad \begin{align*}
\text{a.} & \quad \text{John believes the rumor that Mary left.} \\
& \quad \equiv \text{John believes that Mary left.} \\
\text{b.} & \quad \text{John knows the rumor that Mary left.} \\
& \quad \not\equiv \text{John knows that Mary left.} & \text{(Uegaki 2016: 626)}
\end{align*}\]

Uegaki argues that only a propositional-embedding predicate can yield the entailment in (3a), and if *know* were also embedding propositions, there would be no way to derive the contrast between (3a) and (3b). There is no way, he claims, for the rumor that Mary left to denote a proposition without yielding the entailment of (3b). The question-embedding approach to ResPs must also argue on independent grounds why any verb should be purely rogative.

A third option is to dispense with the assumption that declaratives and interrogatives denote
different sorts of formal semantic objects to begin with, a treatment baked into frameworks like Inquisitive Semantics (Ciardelli et al., 2013; Theiler et al., 2016; Roelofsen, 2017; Roelofsen et al., to appear). Under such a view, the existence of ResPs is not only expected, but it is the default behavior of clausal-embedding verbs; the behavior of (anti-)rogatives must be derived on independent grounds. This option will not be considered in detail here, as the predictions it generates for ResPs are identical to the question-embedding perspective; both treat the denotation of any ResP complement clause as a set of propositions. Because this paper is only concerned with responsive predicates, it cannot adjudicate between this approach and a question-embedding approach.²

Ultimately, the treatment of ResPs should be empirically motivated: can we find ResPs whose meaning is fundamentally incompatible with one type of complement or another? In this paper, I will argue that the answer to this question is yes—and that the question-embedding semantics of ResPs is preferable—based on novel data from the Estonian verb mõtlema ‘think, consider’. The basic fact which comprises the bulk of the argument is that mõtlema canonically signals that the attitude holder stands in a belief relation to an embedded declarative (4a), and an ignorance relation to the true answer to embedded interrogative (4b)-(4c):

(4) a. Liis mõtleb, et sajab vihma.
   Liis MÕTLEMA that falls rain
   ‘Liis thinks that it’s raining.’

   b. Liis mõtleb, kas sajab vihma.
   Liis MÕTLEMA Q falls rain
   ‘Liis wonders whether it’s raining.’

   c. Liis mõtleb, kus sajab vihma.
   Liis MÕTLEMA where falls rain
   ‘Liis wonders where it’s raining.’

The chimerical behavior of mõtlema, in which its interpretation is fundamentally dependent on the type of its complement, is superficially surprising. However, I argue that mõtlema provides evidence in favor of the question-embedding account. In a nutshell, mõtlema indicates that an individual is thinking about something. That something cannot be plausibly thought of as being propositional.

The paper is structured as follows. Section 2 discusses properties of the mõtlema and argues that its behavior cannot be fully capture by a proposition-taking semantics. Section 3 introduces the idea of a contemplation state and argues that mõtlema can be profitably analyzed as simply situating an embedded question in an attitude holder’s contemplation state. Section 4 derives the interpretation of mõtlema in context from its denotation and general pragmatic principles. Section 5 concludes.

²Groenendijk and Stokhof (1984, 1989) also treat clausal complements as uniform, but, for them, the denotation of embedded questions is propositional.
2. The case of Estonian mõtlema

What is striking is that mõtlema seems to convey radically different attitudes—paraphrasable roughly as think and wonder—depending on the type of its complement. A natural reaction to examples like (4) would be to simply assume that there are two different lexical items who share the same phonological form of mõtlema: one which takes a declarative complement and one which takes an interrogative.

While this approach could quite possibly achieve descriptive adequacy, I believe it falls short of explaining the pattern for at least two reasons. The first is that mõtlema is not alone in this kind of behavior even in Estonian: similar patterns can be observed with mõtisklema ‘consider’, vaatlema ‘observe,’ and meelisklema ‘muse’.

Furthermore, the Finnish verb miettiä, a presumed cognate of mõtlema, displays the same sort of behavior, suggesting that the generalizations to be derived about mõtlema can at least be extended to neighboring languages:

(7) a. Mietin, olisi=ko nyt hyvä hetki myydä. 
   ‘I wonder whether now would be a good time to sell.’

b. Mietin, että nyt voisi olla hyvä hetki myydä. 
   ‘I think that now might be a good time to sell.’

The second argument against a bifurcated lexical approach comes from conjunction. A declarative and interrogative complement can be felicitously conjoined under a single use of mõtlema with a sufficiently rich context. In these instances, the interpreted attitudes are equivalent to each clausal complement with mõtlema in isolation.

(8) Context: Your computer won’t turn on. You think the problem is the hard drive, but you aren’t completely sure so you take it to a computer repair shop. You also don’t know if your computer is beyond the point of saving. Later, you tell your friend:

3http://opleht.ee/2014/03/kolmeteistkumnenda-aasta-kolmteist-parimat-2/
4Thank you to an anonymous reviewer for these examples.
Ma mõtlen, et mu kõvaketas on katki ja kas nad saavad selle korda. I MÕTLEMA that my hard.disk is broken and Q they can.3PL it.GEN fix.INF ‘I think that my HDD is broken and I wonder if they can fix it.’

These two uses of mõtlema in (4) seem at odds with one another, given that belief and ignorance are contradictory. While belief is doxastic commitment on the part of the attitude holder towards a proposition \( p \), ignorance entails the absence of any such commitment to \( p \) or any of its alternatives. Cross-linguistically, verbs that encode representational belief (in the sense of Hintikka 1962) when taking a declarative complement typically do not also permit interrogative complements (Egré, 2008; Spector and Egré, 2015) modulo doxastic factives like know.

Therefore, an analysis of mõtlema has two major desiderata: one, it needs to treat clausal complements in a unified way, and two, it needs to derive the interpretation of mõtlema with different complements. In pursuit of these goals, I turn now to consider what, exactly, mõtlema can mean in different contexts.

2.1 Interpretation with embedded declaratives

Out of the blue, mõtlema utterances with declarative complements are interpreted simply as belief ascriptions:

(9) Nad mõtlebav, et valijad on lammad.
    they MÕTLEMA that voters are sheep ‘They think that voters are sheep.’

However, mõtlema differs from the ResP know (and its Estonian counterpart teadma), in that it is nonfactive, despite the fact that both verbs can be used to ascribe a belief to an attitude holder. Hence, although the but-clause in (10) is judged infelicitous because in contradicts the presupposition introduced by know, its correspondent in (11) is not:

(10) Ambrose knows that it is raining, #but it isn’t raining.

(11) Liis mõtleb, et sajab vihma, aga ei saja.
    Liis MÕTLEMA that falls rain but NEG fall.NEG ‘Liis thinks that it’s raining, but it isn’t raining.’

Mõtlema may also be used to attribute beliefs to third parties with whom the speaker disagrees: in (12), the speaker indicates that Aarne has a belief that Helsinki is in Sweden, and follow up this claim with an explicit declaration that the attitude holder is incorrect. In these cases, mõtlema behaves similarly to well-studied verbs of representational belief like think and believe, or their approximate Estonian counterparts, arvama and uskuma.

(12) Aarne mõtleb, et Helsingi on Rootsis. Ta on nii loll!
    Aarne MÕTLEMA that Helsinki is Sweden.NESS he is so dumb ‘Aarne thinks that Helsinki is in Sweden. He’s so dumb!’
Unlike *arvama, mõtlema* may be used to introduce beliefs not actually held by the attitude holder in the world of evaluation, but rather hypothetical scenarios she is entertaining. For instance, in (13), the speaker is explicit about her commitment to dinosaurs not being alive, but nonetheless, she is considering the counterfactual situations in which they are indeed alive.

(13) **Context:** I am discussing with my friend what life would be like if an asteroid had not collided with the earth at the end of the late Cretaceous period.

Ma {mõtlen/#arvan}, et dinosaurused on ikka elus, kuigi ma tean, et ei MõLEMA/think that dinosaurs are still alive although I know that NEG ole. 
be.NEG
‘I’m thinking about dinosaurs still being alive, even though I know that they aren’t.’

In all, the interpretation of *mõtlema* with a propositional argument $p$ is dependent on the speaker’s assessment of the attitude holder’s doxastic state. If the attitude holder is assumed to hold a belief that $p$, *mõtlema* can felicitously be used to describe this belief. However, if the context is such that the speaker’s beliefs contradict $p$, then *mõlema* receives an imaginal interpretation. These generalizations are summarized in (14).

(14) Interpretations of $x$ mõtlema $p$

<table>
<thead>
<tr>
<th>$DOX^w_x \subseteq p$</th>
<th>$DOX^w_x \cap p \neq \emptyset$</th>
<th>$DOX^w_x \cap p = \emptyset$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$x$ mõtlema $p$</td>
<td>‘$x$ thinks $p$’</td>
<td>‘$x$ imagines $p$’</td>
</tr>
</tbody>
</table>

2.2 Interpretation with embedded interrogatives

Unlike with declarative complements, *mõlema* with an embedded interrogative typically has an inquisitive flavor. For instance, a speaker could felicitously utter (15) in a context in which she is not expecting any company and there is a knock by an unknown person at the door:

(15) Ma mõtlen, kes ukse taga on. 
    Liis 1SG think. who door.GEN behind is
    ‘I wonder who is at the door.’

Given that *mõlema* does not seem to entail commitment with an embedded declarative, it is worth asking ourselves whether it entails agnosticism to the true answer to an embedded interrogative. As it turns out, the answer is no, given a sufficiently rich context.

(16) **Context:** Liis hears a knock at the door. She was expecting her friend Kirsi to come over, but she fantasizes for just a moment all the famous celebrities who could be showing up instead.

Liis mõtleb, kes ukse taga on, kuigi ta teab, et on Kirsi. 
Liis thinks who door.GEN behind is although she knows that is Kirsi
Again, just as with embedded declaratives, the interpretation of mõtlema with an embedded interrogatives depends on the attitude holder’s doxastic state: if she is agnostic about the true answer to q, mõtlema is much like English wonder, but if she is not, then the question is treated as ‘musing’ or ‘hypothetical’.

(17) Interpretations of x mõtlema q

\[\exists p_n \in q[\text{DOX}_x \subseteq p_n] \quad \nexists p_n \in q[\text{DOX}_x \subseteq p_n]\]

\[x \text{ mõtlema } q \quad (q = \{p_1, p_2, \ldots\})\]

‘x thinks about q’ ‘x wonders q’

2.3 Challenges for Proposition-Taking Theories of ResPs

The two main reductive approaches for the semantics of ResPs, as discussed in §1, are to treat all their clausal complements as proposition-denoting or question-denoting. While in principle the proposition-denoting story is appealing, as it makes the simplifying reduction from questions to propositions as opposed to the complexifying operation in the other direction, mõtlema is simply not compatible with a propositional semantics when it has an interrogative complement.

The motivations for the proposition-taking analysis of ResPs are, at first brush, incredibly appealing. George (2011) and Spector and Egré (2015) articulate a key intuition about the relationship between the meanings of responsive predicates with declarative complements (18a) and interrogative complements (18b). Namely, that in worlds where the handmaiden is the true chalice thief, (18a) and (18b) are essentially equivalent:

(18) a. Gertrude knows that the handmaiden stole the chalice.
   b. Gertrude knows who stole the chalice.

To put it more plainly, to know an embedded interrogative q means, for some p that is the true answer to q, to be in a know-relationship to p. This straightforward propositional meaning for interrogative complements does not hold for rogative verbs like ask, which do not similarly encode a relationship between an individual (namely the ‘attitude holder’) and a proposition.

(19) a. Agatha asked what Vlad added to the tripe.
   b. *Agatha asked that Vlad added polonium to the tripe.

Under this view, ask is a bonafide question-taking verb, but know selects propositions. In Estonian, if we consider only the semantics of teadma ‘know’, this pattern holds up: teadma q is interpreted as teadma p for some p which is an answer to q:

(20) Eestlased teavad, mis kohv on Ladina-Ameerikast.
Estonians know what coffee is Latin-American.
‘Estonians know which coffee is Latin American.’
For Spector and Egré (2015), these observations are taken as evidence that ResPs take propositional complements. However, the pattern is not the same for mõîlema: not only does mõîlema q not entail mõîlema p for any p which is an answer to q, it implicates ignorance on the part of the attitude holder:

(21) Liis mõîleb, kes ukse taga on.  
    Liis thinks who door:GEN behind is  
    ‘Liis wonders who’s at the door.’  
    ~Liis doesn’t know who’s at the door.

While the propositional complement analysis correctly predicts that responsive predicates can embed both declaratives and interrogatives, this is a feature shared with the question-embedding account. In addition to the burden of coming up with a propositional meaning for the interrogative complement in (21), the account faces two chief explanatory hurdles. The first is that there must be an operator or other mechanism which does the clausal type-shifting of interrogative ResP complements to begin with, which in the absence of independent motivation must be stipulated. The second is that additional stipulations are required to explain the ungrammatically of sentences like (22), where an anti-rogative verb appears with an embedded interrogative:

(22) *Shirley thinks whether she will win the lottery.

If type-shifting of embedded interrogatives is an available option for ResP complements, an independent reason for ruling out sentences like (22) is required. Accounts vary on how precisely they achieve this, though many problems arise from the various approaches. While an examination of each of these approaches is outside the scope of this paper, more extensive argumentation about the inadequacies of a question-to-proposition complement approach can be found in Uegaki (2016).

3. Mõîlema as a question-embedding verb

In order to capture the ”contemplative” nature of a mõîlema utterance, I propose that contemplatives like mõîlema straightforwardly denote a relationship between an attitude holder and what I term her **CONTEMPLATION STATE**, and as I will argue, this denotation captures mõîlema’s intuitive range of meanings combined with relatively fundamental pragmatic principles.

3.1 Contemplation states

Attitude verbs specify relationships between attitude holders and propositions in a variety of different ways. For instance, some verbs make reference to an individual’s beliefs, such as the many attitude verbs which relate propositions to the doxastic states of individuals like think and believe (Hintikka, 1962; Kratzer, 2006; Anand and Hacquard, 2013, 2014: *inter alia*). Others, like want, relate an attitude holder to her desires.
It is a question of serious theoretical importance which attitudes linguistic expressions are sensitive to. The intuition with mótlema utterances is that they are used to describe the content of what one is thinking about, rather than what they are committed to. It is easy, for instance, for one to think about both the way the world is and the ways it could be, and compare those side by side. I define this imaginal space as a ‘contemplation state’ of an individual as in (23).

(23) A contemplation state of an individual \( x \) \( \text{CONTEM}^w \) is the set of pairs of sets of worlds and issues (sets of sets of worlds) \{\langle W_1, Q_1 \rangle, \langle W_2, Q_2 \rangle, \ldots, \langle W_n, Q_n \rangle\} such that for all \( \langle Q_m, W_m \rangle \), \( Q_m \) is a partition of \( W_m \) and \( Q_m \) is under active consideration by \( x \) in \( w \).

In prose, a contemplation state consists of pairs of sets of worlds of evaluation \( W \) and ways of carving up that set of worlds \( Q \), much like the partition semantics for questions of (Groenendijk and Stokhof, 1984). A contemplation state is, in effect, an attitude holder’s ‘mental workspace.’ The precise \( W \) may vary: a potential default \( W \) might be the set of world’s compatible with \( x \)’s beliefs, since frequently people are tasked with situating themselves in (and uncovering truths about) the actual world modeled by their beliefs. There are, of course, many possible partitions over the same domain of worlds; and as the definition is formulated here, multiple questions may in principle be in an agent’s contemplation state simultaneously.\(^5\)

3.2 Mótlema and contemplation

With the definition of contemplation in mind, I propose that mótlema straightforwardly denotes a relationship between an attitude holder and an embedded question, and militates that that question forms a partition in the attitude holder’s contemplation state. The formal denotation for mótlema is given in (24).

(24) \([mótlema]^w = \lambda x, \lambda Q_{(st,t)}, \exists W, Q [\langle W, Q \rangle \in \text{CONTEM}^x]\]

Informally, this denotation captures the intuition that mótlema is used to indicate that an individual is thinking about a question: but while this question is under active consideration, the attitude holder need not have any other attitude in particular toward it.

Given the denotation of a contemplative verb complement as that of a question, it is necessary to invoke some sort of type-shifting operation for the complements that superficially appear to be declaratives. Following Uegaki (2016), I utilize the type-shifting operator \( \text{ID} \), which takes a proposition as an argument and returns the singleton set containing that proposition. For independent evidence motivating the existence of this sort of type-shifting operator, see Partee\(^5\)

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\(^5\)These questions may even be partitions of different \( W \)’s, as in examples like the following:

(i) Context: I invited John and Mary, two professors, for dinner. Only one said they would come, but I can’t remember which, but I know that they don’t have the same taste in food.
I am contemplating which professor is coming to dinner and what I will cook.

It is not difficult to imagine that the speaker’s space of possible meals to cook is at least partially dependent on which professor will be in attendance. Should we involve a contemplation state in the meaning of the English verb contemplate, the relevant questions may partition different sets of worlds.
What ID allows us to do is pair mõtlema with embedded declaratives without a type mismatch. If mõtlema Q implicates ignorance, it may not be immediately obvious why mõtlema P does not generate the same implicature; the derivation of different interpretations of mõtlema will be elaborated in Section 4.

3.3 Comparison with Rawlins (2013)

The idea of non-representational ways of reasoning about alternatives is not new. Rawlins (2013), for instance, references the related but distinct concept of abstract ‘content.’ Content, in the sense of Hacquard (2006, 2010), is a property of eventualities: the content of a belief eventuality, for instance, is the intersection of all of the propositions that the relevant individual believes.

Rawlins’s notion of content is slightly different. For him, content is a curried equivalence relation on worlds, which partitions ℳ into sets of worlds which satisfy this equivalence relation, intuitively partition the space of possible worlds as a set of alternatives.

Unlike Rawlins’s content, the idea of contemplation introduced here is inherently cognitive and agent-oriented, like belief or desire. The primary empirical focus of Rawlins is English PPs headed by the preposition about, which is highly promiscuous in the sorts of complements it may appear in. The motivation of contemplation as I have defined it is a relatively small class of attitude verbs which resist analysis as proposition-embedding despite their frequent use in representational contexts.

Rawlins proposes that attitude predicates like think denote content-bearing properties of eventualities in the vein of Kratzer (2006) and Moulton (2009). But a reason we might wish to have a distinct notion of contemplation apart from content is precisely the fact that we see verbs like mõtlema and contemplate, which appear with declarative and interrogative complements without the crutch of a content-selecting PP head like about.

As for why not just assume that mõtlema takes content-complements, note also that whereas questions and NPs may be the complement of about, propositions may not. So the types of semantic object that may constitute an argument of an Estonian contemplative versus about may also differ in a more ontologically robust way:

\[ [ID]^w = \lambda p.[\lambda q.q=p] \]

(1986). The denotation of ID is given in (25).

It is also worth mentioning that NPs marked with allative case in Estonian are also permissible as complements of mõtlema:

(i) Ta mõtles Suurele Vennale.  
he MÔLEMA,PAST big,ALL brother,ALL  
‘He thought about Big Brother.’

It might be tempting for this reason to throw up our hands and simply treat mõtlema as think and the allative case as about here–however, the allative case marking is not licensed in other complements of mõtlema, nor does
(26) *Joyce thought about (that) it was raining.

In short, Rawlins’s content and my contemplation states broadly share similarities in describing ontologically underspecified notions of largely conceptual semantic objects as partitions over sets of worlds. Contemplation is fundamentally attitudinal: a tool of characterizing particular mental states, namely the internal consideration of a question which may or may not be resolved. Content is also a general way of describing the content of an attitude as an equivalence relation over sets of worlds. One way in which contemplation is perhaps more flexible is in the ability of different elements in the contemplation state to partition different sets of worlds with different contextual domain restrictions; it is not clear how such cases might be tackled in Rawlins’s system.

3.4 Comparison with Ciardelli and Roelofsen (2015)

The approach sketched here also overlaps in many ways with Ciardelli and Roelofsen’s (2015) extension of epistemic logic, in which agents can both know information and entertain issues. In particular, there is some similarity between contemplation and C&R’s entertain modality $E_a$, which has the following semantics:

(27) Semantics of $E_a$ (C&R 2015: 3.4)

\[
\langle M, s \rangle \models E_a \varphi \iff \text{for any } w \in s \text{ and for any } t \in \Sigma_a(w), \langle M, t \rangle \models \varphi
\]

In other words, an agent $a$ entertains $\varphi$ iff in each world $w$ in her information state, every resolution of her inquisitive state supports $\varphi$. When $\varphi$ is interrogative, entertainment is quite similar to contemplation: the speaker declares a particular issue to be settled by resolutions of her inquisitive state.

However, when $\varphi$ is a declarative, $E_a \varphi$ entails knowledge of $\varphi$, since the inquisitive state with respect to $\varphi$ is already resolved.

The crucial difference is that this knowledge entailment is not present for contemplation, which merely asserts that an issue is being considered by an agent, irrespective of her actual beliefs. This is evidenced by ‘faultless retraction’ cases in Estonian with $mõtlemä$, as in the now-familiar dinosaur example:

(28) Ma mõtlemä, et dinosaurused on ikka elus, kuigi ma tean, et ei ole.
    I think that dinosaurs are still alive although I know that NEG be.NEG
    ‘I’m thinking about dinosaurs still being alive, even though I know they’re not.’

If $mõtlemä$ has the denotation in (24), (28) is not contradictory: the speaker’s contemplation of this observation help us understand why $mõtlemä$ can embed declaratives but about cannot. But the connection certainly merits further investigation.
the existence of dinosaurs may or may not match her true beliefs. But if mōtlema denotes $E_a$, (28) is contradictory: the speaker indicates she believes both that dinosaurs are still alive and that they are not alive.

We can rectify this contradiction if each clause is evaluated dynamically relative to a different information state: In the mōtlema-clause, the speaker behaves as if she is adopting an information state in which dinosaurs exist. In the second clause, the speaker reveals that her information state in $w_0$ is one in which dinosaurs do not exist.

But, if an information state-shifting mechanism is in principle a possibility, we have no reason to expect the infelicitous English example in (29) should be anomalous:

(29) #I wonder why dinosaurs are still alive, even though I know they aren’t.

While the contem modality and the $E$ modality are similar both in nature and intent, the fact that $E_a \phi$ entails $K_a \phi$ in C&R’s logic necessitates additional mechanisms to correctly predict the felicity of faultless retraction with mōtlema.

4. Pragmatic derivation of meaning with mōtlema

4.1 Embedded interrogatives

Recall one of the central puzzles presented in this paper: how do verbs like mōtlema yield such different interpretations dependent solely upon the type of their complement? The semantics here involves an agent weighing a set of alternatives—different possible resolutions to a question—against one another. If a mōtlema-sentence expresses a purely mental calculus about an agent’s evaluation of alternatives: why should such a sentence indicate anything about ‘wondering’ or ‘ignorance’?

Upon closer investigation, that mōtlema with an embedded interrogative canonically implicates ignorance is unsurprising given its semantics. If a person is weighing different alternative answers to a question against one another, the most natural reason for them to do so is that they are seeking the true answer to the question. While people can and do ‘muse’ about questions regularly, the precise reason for them doing so becomes much clearer in context. If a knock is heard at the door, a speaker who utters (28) can reasonably be understood to be ignorant of the true identity of the knocker. If they did in fact know who was at the door, it would be quite bizarre for them to indicate they were merely thinking about the possible alternatives, because it would not be a sufficiently informative reaction to the situation, a Quantity violation in the spirit of Grice (1975).

We can generalize this intuition: in any case where a mōtlema $P$ alternative to a mōtlema $Q$ utterance could have been cooperatively uttered by the speaker to further a conversational goal, the mōtlema $P$ version will be more informative. To illustrate, let us revisit the now familiar case of (4), reprinted below as (30), with the attitude holder’s contemplation state:
a. Liis mõtleb, et sajab vihma.
Liis thinks that falls rain
‘Liis thinks that it’s raining.’
\[\text{CONTEM}_{Liis} = \langle \{\text{it is raining}\}, W_1 \rangle\]

b. Liis mõtleb, kas sajab vihma.
Liis thinks Q falls rain
‘Liis wonders whether it’s raining.’
\[\text{CONTEM}_{Liis} = \langle \{\text{it is raining, it is not raining}\}, W_2 \rangle\]

In both cases, the W—the set of worlds under consideration—is taken by default to be the set of worlds compatible with Liis’s beliefs in the absence of evidence to the contrary. In the case of (30a), Liis is only considering worlds in which it is raining, whereas (30b) includes both rain-worlds and non-rain-worlds. Holding all of Liis’s other beliefs constant, the set of worlds in Liis’s contemplation state in (30b) is a superset of those in (30a).

Because (30b) allows for there to be both rain-worlds and non-rain-worlds in Liis’s contemplation state—and again, these worlds are those compatible with Liis’s beliefs. Because there is the additional possibility of non-rain-worlds in Liis’s contemplation state with the embedded interrogative but not the embedded declarative, (30a) is a strictly more informative utterance. If only the proposition ‘it is raining’ is compatible with Liis’s doxastic state, there is a pragmatic preference for uttering (30a) over (30b).

There are cases where mõtlema Q does not license an ignorance inference, but these are precisely the sort of cases where the ‘contemplative’ nature of an agent is at-issue.

(31) Context: Siim is reading a book about Estonian history. It got him thinking about all the reasons there were for Estonia to lose the war with Russia in the 1500s.

Siim mõtleb, miks Eesti kaotas sõja.
Siim thinks why Estonia lost war
‘Siim is thinking about why Estonia lost the war.’

In context, Siim knows full well why Estonia lost the war: for the reasons delineated in his book. Nonetheless, the topic sparked his imagination, and all of those reasons—as well as possible alternatives—are now a topic of active consideration for him. He is not ignorant as to why the war was lost, but merely a curious pontificator. While mõtlema can implicate ignorance towards an embedded question, this arises from the pragmatics of contemplation, rather than an entailment in the lexical entry for mõtlema.

This is a different route to agnosticism than the one taken by true anti-rogatives. For instance, (Uegaki, 2016) takes anti-rogatives like wonder to presuppose ignorance: i.e., that at least two of the alternatives in the embedded interrogative are live possibilities for the attitude holder. This is cashed out as a presupposition of these predicates that the cardinality of their complement is at least 2.

(32) \[[\text{wonder/ask/inquire}]^W(Q)(x) \text{ is defined only if the following proposition is compatible}\]
with x’s beliefs: \( \lambda w. \exists p \in Q[p(w)] \land \exists p \in Q[\neg p(w)] \) (Uegaki 2016: 647)

While Uegaki’s presupposition captures the facts nicely for wonder, it does not make quite the right predictions for all anti-rogatives, like Estonian kūsima ‘ask’. Consider the following sentence, uttered to describe a pedagogical context:

(33) Œpetaja küsib, kas [p] ahtushäälik on.

‘The teacher asks whether [p] is a fricative.’

Presumably the teacher actually knows the answer to the embedded question; (33) simply describes an inquisitive speech act he is performing in order to quiz students on their knowledge. By the letter of Uegaki’s definition, this renders the presupposition of kūsima unsatisfied. What is crucial is that the teacher is behaving as though he does not know the answer to the question in some relevant way. Therefore, I propose a small tweak to Uegaki’s definition, bolded:

(34) \([\text{wonder/ask/inquire}]'(Q)(x)\) is defined only if the following proposition is compatible with what x presents to be x’s beliefs: \( \lambda w. \exists p \in Q[p(w)] \land \exists p \in Q[\neg p(w)] \)

Since wonder can only take questions as complements, this requires that the subject is ‘wondering’ about at least two possible alternatives. Even if the type-shifted version of an embedded interrogative is available to wonder, a question-version of a declarative sentence contains only one proposition. While I hesitate to make a direct comparison between mõtlema and wonder per se, suffice it to say that mõtlema has no such presupposition of ignorance—which may, in turn, connect to its freer range of permissible complements than wonder.

4.2 Embedded declaratives

We have seen many uses of mõtlema paired with a declarative complement which most naturally generates a belief interpretation, despite the fact that nothing about the proposed contemplative semantics for mõtlema entails such an interpretation. To see how belief interpretations may naturally arise, consider the following:

(35) Mu kass mõtleb, et pitsapoiss on mu omanik.

‘My cat thinks that the pizza boy is my owner.’

In a typical situation, no ignorance of any sort is implicated by uttering (35): the speaker is intending to (anthropomorphically) ascribe a belief to his cat, namely the belief that the pizza boy is the speaker’s owner (the pizza boy brings the speaker food, the ostensible mark of ownership).

Why should this be the case? Note that a mõtlema \( p \) sentence requires its complement to first be type-shifted into a set of propositions through application of ID. The attitude holder is then taken to be contemplating a single-alternative question, which constitutes a trivial partition over
the contextually relevant set of worlds.

For similar reasons to mõtlema q implicating ignorance, mõtlema p implicates belief. If an agent only has one alternative under consideration, a natural inference is that that alternative is the most viable candidate for the actual world, as far as the agent is concerned. Were there to be multiple resolutions to a particular question under discussion (with respect to some agent’s epistemic state), it would be misleading to utter mõtlema p, because the ∼P candidates are not mentioned. In normal circumstances, then, the speaker is taken to be asserting, indirectly, information about an agent’s beliefs. In the case of (35), the speaker emphasizes that his cat is only considering the alternative where the pizza boy is the speaker’s owner, rather than any other possible state of affairs.

This indirect method of belief ascription also naturally carries the implication that the purported belief in P is somehow ‘weaker’ than total commitment. While describing beliefs with mõtlema is frequent in naturally occurring speech, there exist other belief verbs like arvama, uskuma, and teadma which lexically encode this belief. Because alternative ways of describing belief that entail that belief are available, the use of belief-implicating mõtlema is weaker by comparison. In effect, there is pragmatic competition between different verbs which can functionally be used to ascribe belief.

This line of thinking makes empirically testable predictions. For instance, consider the case of predicates of personal taste. When a PPT under a belief verb, the understood interpretation is that the ‘judge’ against whom the truth of the embedded predicate (following Stephenson (2007)) is evaluated is the attitude holder. In the intended interpretation of (36), the speaker’s sister is the one who judges chocolate to be delicious. There is a felicitous use of mõtlema here, under the somewhat anomalous reading where the speaker’s sister is asserting chocolate to be delicious as an objective truth, rather than merely her opinion, deriving the anomalous interpretation that she intends to project her opinion by fiat:

(36) Mu õde {arvab/#mõtleb}, et šokolaad on maitsev.
    my sister thinks that chocolate is delicious
    ‘My sister thinks that chocolate is delicious.’

A speaker’s commitment to her belief in a taste predicate must be total, under the assumption that taste predicates require a ‘judge’ to be semantically evaluated (Stephenson, 2007). Thus, if a commitment-entailing verb exists in the lexicon, ascribing a taste predicate belief to an individual should require the use of such a verb rather than a weaker, commitment-implicating verb like mõtlema.

Along similar lines, in cases where a speaker may intentionally wish to convey their relative lack of commitment, mõtlema should be preferable to arvama. This is indeed borne out. Simons (2007) points out that verbs like think can be used as not-at-issue matrix verbs in cases where speakers wish to distance themselves from commitment to an embedded p or indicate the weakness of their evidence for p. Should this be true, mõtlema is predicted to be preferred to arvama in cases where speakers intend to hedge. This is borne out in (37).

Responsive predicates are question-embedding 285
(37)  Context: My coworker asks where Mary is. I heard a rumor that she was on vacation in Boston, but I don’t really know her well enough to be really sure.

Ma {mõtlen/?arvan}, et Mary on Boston.is.
I think that Mary is BostonINESS
‘I think that Mary is in Boston.’

If a speaker uses arvama in (37), they indicate they have good evidence for knowing Mary’s whereabouts, rather than hearsay or conjecture which might negatively impact their confidence in the assertion. When compared side by side in the same context, arvama is always judged to indicate that the attitude holder has greater commitment towards an embedded proposition than does mõtlema.

It is important, however, to keep in mind that the implicit belief associated with mõtlema is defeasible in a sufficiently rich context. While all else being equal, an utterance of mõtlema p would be likely to be understood as a belief report, in a context in which my beliefs are clearly contrary to that of the proposition that would be denoted by an embedded declarative, mõtlema can be used instead to indicate that I am hypothetically entertaining that proposition, as in the example reprinted below:

(38) Context: I am discussing with my friend what life would be like if an asteroid had not collided with the earth at the end of the late Cretaceous period.

Ma {mõtlen/#arvan}, et dinosaur used on ikka elus, kuigi ma tean, et ei
I MÕTELEMA/think that dinosaurs are still alive although I know that NEG
be.NEG
‘I’m thinking about dinosaurs still being alive, even though I know that they aren’t.’

5. Conclusion

In this paper, I have argued for an analysis of the superficially responsive Estonian verb mõtlema in which its surprising interpretative sensitivity to the type of its complement follows straightforwardly from a sufficiently bleached semantics and general pragmatic principles. Furthermore, the incompatibility of mõtlema’s interrogative complements with propositional interpretations suggest that analyses of responsive predicates which uniformly treat their complements as propositions cannot account for the behavior of at least some ResPs. And while the account presented here maintains the assumption that declarative and interrogative clauses denote different types (à la Uegaki, 2016), it could just as easily fit into the framework of (Theiler et al., 2016), who argue on independent grounds for a uniform typing of clausal complements.

In developing a semantics for mõtlema, also introduced a new type of attitude, contemplation, which broadly concerns an individual’s mental workspace, and offers some empirical advantages over related proposals. The idea of contemplation spaces may also be useful in analyzing clauses which serve as the complements of verbs like contemplate in English, or even those which are complements of prepositions like about. If contemplation is indeed an ontological
primitive to which at least m"otlema is sensitive, we would expect other languages to lexically encode information about contemplation states as well.

Ultimately, however we choose to represent clausal complements, an ideal big-picture account of clausal-embedding verbs would be able to derive their selectional behavior from independent properties of their lexical semantics. However, in order to push this idea to the limit, continued close investigation of these verbs in a wide variety of languages is absolutely essential.

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Presuppositional implicatures: quantity or maximize presupposition?1
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Abstract. Schlenker (2012) proposes that when framed within a modern Stalnakerian view of presupposition and common ground (Stalnaker, 1998, 2002), Maximize Presupposition! (Heim, 1991; Sauerland, 2008) can be viewed as a special case of the maxim of Quantity (Grice, 1975). We provide data suggesting that in some cases, Maximize Presupposition! applies even when speakers are not expected to use a presupposition as vectors of new information. We argue that these data support the view that Maximize Presupposition! is an independent pragmatic principle, distinct from Quantity.

Keywords: maximize presupposition, quantity, presuppositional implicatures, scalar implicatures.

1. Introduction

Much current discussion in pragmatics has been concerned with Maximize Presupposition! (Heim, 1991; Percus, 2006; Chemla, 2008; Sauerland, 2008; Schlenker, 2012), a rule of conversation proposed to account for the infelicity of certain utterances in contexts where a presupposition absent from them is felicitous. More specifically, we say that an utterance \( F \) is infelicitous if there exists some presuppositionally stronger alternative \( F' \) whose presupposition \( p \) is appropriate within the context. Such a statement will be clearer once the notions of presuppositional alternative, presuppositional strength and presuppositional appropriateness are properly defined.

In section 2, we present an overview of Maximize Presupposition! and the so-called presuppositional implicatures it predicts (Leahy 2016). Section 2.1 discusses the principle as it has classically been described (Heim, 1991; Percus, 2006; Sauerland, 2008), viz. as predicting how the use of presuppositionally weak alternatives will generate the inference that the presuppositions of their stronger alternatives are not common belief. In section 2.2, we discuss Chemla’s (2008) arguments that adopting a modern Stalnakerian view of presupposition and common ground (Stalnaker, 1998, 2002) can account for the stronger inferences one gathers from the use of certain presuppositionally weak alternatives. In section 2.3, we discuss Schlenker’s (2012) arguments that within this framework, one can understand presuppositional implicatures as following from the maxim of Quantity (Grice, 1975) rather than from an independent principle such as Maximize Presupposition!.

In section 3, we discuss problems with the proposals of Chemla and Schlenker. In section 3.1, we note that the notion of authority, introduced by Chemla to implement a modern Stalnakerian

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view, is too strong and predicts a number of unattested inferences. We propose to restrict his account by introducing the notion of speaker reliability. In section 3.2, we discuss how this notion makes different predictions depending on whether one treats *Maximize Presupposition!* as an independent principle or as a special case of Quantity. We offer data suggesting that it favors treating the principle as independent. In an appendix, which is not essential to our arguments, we spell out a proof of a result that is assumed in Chemla (2008).

2. Previous accounts of presuppositional implicatures

2.1. *Maximize Presupposition!*

In order to define the notion of presuppositional alternative, we must first define the set of presuppositional scales (Percus, 2006). Much like the scales used to define alternatives in neo-Gricean accounts of scalar implicature (Horn, 1972; Gazdar, 1979), this set will consist of a list of given pairs of lexical items. Here, we assume the set to contain exactly three elements, *viz.* the pairs *(a(n),the), (all,both)* and *(believe,know).*

(1) Presuppositional scales

The set of presuppositional scales $\Sigma_\pi = \{ (a(n),the), (all,both), (believe,know) \}$

A given utterance will be a presuppositional alternative to another whenever both utterances differ syntactically only with respect to the substitution of one member from a scale for another member of that scale.

(2) Presuppositional alternatives

$F'$ is a presuppositional alternative to $F$, written as $\text{Alt}_\pi(F',F)$, iff $F'$ is identical to $F$ save for the substitution of one member of a scale in $\Sigma_\pi$ for another of that same scale.

We say that $F'$ is presuppositionally stronger than $F$ whenever the set of worlds in which $F$ is neither true nor false strictly entails the set of worlds in which $F'$ is neither true or false.

(3) Presuppositional strength

$F'$ is presuppositionally stronger than $F$, written as $F' \prec_\pi F$, iff

$$\{ w \in W : F = \# \} \subset \{ w \in W : F' = \# \}$$

The scales assumed above have been laid out in such a way as to ensure that the substitution of the rightmost element of a given scale for its leftmost element results in a presuppositionally stronger alternative. Indeed, we will assume that the extensions of the members of any given scale are identical save for an added presupposition in the item on the right. The table below (Marty, 2017) displays for each scale what the added presupposition of the rightmost item is.

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2 See Rouillard and Schwarz (2017) for an account of presuppositional alternatives which dispenses with scales and opts instead for a complexity based account to alternatives modeled on that of Katzir (2007) for scalar implicatures.

3 One might argue that another important condition on some $F'$ being presuppositionally stronger than some $F$ would be that both share the same asserted content. While this is certainly true, the scales assumed here make stating this condition unnecessary for our purposes.
We will for the moment assume that an utterance $F'$ is presuppositionally appropriate whenever for any proposition $p$ presupposed by an utterance of $F'$, $p$ is common belief. The notion of common belief is defined relative to the set of beliefs of the speaker $s$ and her addressee $a$. Assuming the operator $B_i$ to signify ‘$i$ believes ...’, we can define the set $\mathcal{B}$ of higher-order beliefs of $s$ and $a$ according to the recursive definition in (4) (Stalnaker, 2002; Chemla, 2008; Schlenker, 2012).

\[
\begin{align*}
(4) & \quad (i) \quad \forall i \in \{s,a\}, B_i \in \mathcal{B} \\
& \quad (ii) \quad \forall B, B' \in \mathcal{B}, BB' \in \mathcal{B} \\
& \quad (iii) \quad \text{Nothing else is in } \mathcal{B}
\end{align*}
\]

Using this definition for $\mathcal{B}$, we can now define what it means for a proposition $p$ to be common belief.

\[
(5) \quad \text{Common Belief}
\]

A proposition $p$ is common belief, written as $C[p]$, iff for every $B$ in $\mathcal{B}$, $B[p] = 1$.

For an utterance $F'$ to be presuppositionally appropriate, it must be the case that each of its presuppositions be common belief. That is, for any given $p$ presupposed by $F'$, it must be the case that $B_s[p], B_a[p], B_sB_a[p], B_aB_s[p], B_sB_s[p], B_aB_a[p]$, ad infinitum.

\[
(6) \quad \text{Presuppositional appropriateness}
\]

$F'$ is presuppositionally appropriate, written as $\text{App}_\pi(F')$, iff for all $p$ presupposed by $F'$, $C[p]$

A formal definition of Maximize Presupposition! (MP) can now be given in (7), which takes a form similar to that of a conversational maxim.

\[
(7) \quad \text{Maximize Presupposition!}
\]

A speaker $s$ must not utter some $F$ if there is an $F'$ such that $s$ believes that:

\[
\begin{align*}
(i) & \quad \text{Alt}_\pi(F', F) \\
(ii) & \quad F' \prec_\pi F \\
(iii) & \quad \text{App}_\pi(F')
\end{align*}
\]

The literature on presuppositions reports the infelicity of examples such as those in (8a-10a) to be attributable MP (Heim, 1991; Singh, 2011).

\[
(8) \quad \begin{align*}
a. & \quad \#\text{An independence of the United States is celebrated in July.} \\
b. & \quad \text{The independence of the United States is celebrated in July.}
\end{align*}
\]
Given the scales assumed above and the extensions assumed for their members, it follows that the \( b \) examples are presuppositionally stronger alternatives of the \( a \) examples, meaning that (7i) and (7ii) are met for MP. Moreover, in any normal context, the presupposition of the \( b \) examples will be common ground, ensuring that (7iii) is also met. Hence, the infelicity of the \( a \) examples is straightforwardly captured by the definition of MP in (7).

More than simply predict the infelicity of utterances who have presuppositional alternatives appropriate in all normal contexts, MP also predicts that one will draw inferences whenever the presuppositionally weaker of two alternatives is employed (Percus, 2006; Sauerland, 2008). Indeed, it will follow from the utterance of a weak presuppositional alternative that the speaker does not believe the utterance of its stronger counterpart to have been appropriate. According to the definition of appropriateness assumed so far, this will lead to the inference that the speaker does not believe that the presupposition of the stronger alternative is common belief. Such presuppositional implicatures (PIs) are illustrated by the examples in (11-13).

(11) John is looking for the number of a girl he met in Berlin.
    PI: \( \neg B_s C[that \, John \, met \, exactly \, one \, girl \, in \, Berlin] \)

(12) All of the papers Mary submitted were rejected.
    PI: \( \neg B_s C[that \, Mary \, submitted \, exactly \, two \, papers] \)

(13) John believes that Mary is pregnant.
    PI: \( \neg B_s C[that \, Mary \, is \, pregnant] \)

Ascertaining whether such inferences are in fact drawn from the examples in (11-13) is a difficult task due in no small part to how weak the predicted inferences are. Indeed, for it not to be the case that \( s \) believes that \( p \) is common belief, it need only be the case that for some arbitrary \( B \) in \( \mathcal{B} \), \( \neg B_s B[p] \). Thus for example, it will not be the case that \( s \) takes \( p \) to be common belief in cases ranging from her believing \( p \) to be false, believing that \( a \) takes \( p \) to be false, believing that \( a \) is unsure about the truth of \( p \), being unsure herself of the truth of \( p \), believing that \( a \) does not believe \( s \) to believe \( p \) to be true, and so on. Certainly the weakness of such an inference casts doubt on the value of its prediction by MP, as any attempt to test for the presence of such an inference seems entirely hopeless.

2.2. Authority (Chemla 2008)

Chemla (2008) notes that the notion of presuppositional appropriateness discussed in (6) is too weak to capture the inferences one intuitively gathers from the utterance of certain presuppositionally weak alternatives. Indeed, what one infers from an utterance of the examples in (14-16) is not simply that \( s \) does not take the presupposition of their stronger alternatives to be common
ground, but rather that s herself does not believe the presupposition of these alternatives to be true.

(14) A bathroom in my apartment is flooded.\(^4\)
- Predicted PI: \(\neg B_s C[\text{that there is exactly one bathroom in s’s apartment}]\)
- Actual PI: \(\neg B_s [\text{that there is exactly one bathroom in s’s apartment}]\)

(15) All my brothers fought in Vietnam.
- Predicted PI: \(\neg B_s C[\text{that s has exactly two brothers}]\)
- Actual PI: \(\neg B_s [\text{that s has exactly two brothers}]\)

(16) John believes that I have a sister.
- Predicted PI: \(\neg B_s C[\text{that s has a sister}]\)
- Actual PI: \(\neg B_s [\text{that s has a sister}]\)

Chemla proposes to solve this problem by transitioning to a modern Stalnakerian view of presupposition and common ground (Stalnaker, 1998, 2002). Under this account, Stalnaker defines presuppositional appropriateness similarly to how it was defined in (6), meaning that for a speaker to presuppose \(p\) is appropriate implies that \(B_s C[p]\). However, the innovation in this account is that appropriateness is defined not as requiring \(p\) to be common belief prior to its presupposition by \(s\), but after it has been presupposed. The driving force behind this idea is that if after \(p\)’s presupposition \(a\) comes to believe \(p\), then it will follow that \(C[p]\). In order to address this issue, we refer to Chemla’s proposal that an epistemic step is involved in the derivation of PIs, which appeals to the notion of authority. A speaker \(s\) is an authority relative to \(a\) and with respect to some presupposition \(p\) whenever \(s\) presupposing \(p\) will cause \(a\) to accommodate and believe \(p\). More generally, authority can be viewed as a special case of the assumption that \(s\) is correct in her beliefs, and this by assuming that whenever \(s\) presupposes \(p\), she is committed to the truth of \(p\). To this effect, we adopt Schlenker’s (2012) formalization of authority below.

(17) Authority
\[
B_a[B_s[p] \Rightarrow p]
\]

A concept such as authority offers a new way of describing presuppositional appropriateness. In order for some \(F’\) to be presuppositionally appropriate, the maxim of Quality (Grice, 1975) requires a cooperative speaker to believe every presupposition he makes when uttering \(F’\). However, rather than require that some \(p\) be common belief prior to its presupposition by \(s\), all that is needed is for \(s\) to be an authority on \(p\) such that \(p\) becomes common belief following \(s\)’s presupposition of \(p\).\(^5\)

(18) Presuppositional appropriateness
\[
\text{App}_s(F’) \text{ iff for all } p \text{ presupposed by } F’, B_s[p] \land B_a[B_s[p] \Rightarrow p]
\]

Now consider once again the examples in (14-16) in light of our new notion of presuppositional

\(^4\)This example was devised by Michael Wagner. (p.c.)

\(^5\)See the appendix for a discussion on how the notion of presuppositional appropriateness in (18) paired with the assumption that \(s\) is an authority on some presupposition \(p\) is sufficient to guarantee that a presupposition \(p\) becomes common belief following its utterance.
appropriateness. For \( s \) to utter these presuppositionally weak alternatives will cause \( a \) to infer that \( s \) does not believe that uttering their stronger alternatives is appropriate (\( \neg B_s[B_s[p] \land B_a[B_s[p] \Rightarrow p] \)). In other words, from an utterance of weaker alternatives, \( a \) will derive the PI that either \( s \) does not believe \( p \) or that \( s \) does not believe that she is an authority on \( p \).

\[
(19) \quad \text{Presuppositional implicature} \\
\neg B_s[p] \lor \neg B_s B_a[B_s[p] \Rightarrow p]
\]

The epistemic step Chemla proposes in order to obtain the inferences observed in (14-16) relies on the interaction between the predicted disjunctive PIs in (19) and what he dubs the Authority Assumption (AA). Simply put, the AA is an assumption made by \( a \) whereby she assumes that \( s \) believes herself to be an authority on \( p \).

\[
(20) \quad \text{Authority assumption} \\
B_s B_a[B_s[p] \Rightarrow p]
\]

With our new definition of presuppositional appropriateness and the AA, it becomes easy to see how one obtains from (14-16) their attested inferences. Let \( F \) be any of these utterances and \( F' \) be its presuppositionally stronger alternative such that \( F' \) presupposes \( p \) but \( F \) does not. MP predicts that an utterance of \( F \) by \( s \) will lead \( a \) to draw the PI in (19). However, in these cases, \( a \) assumes that \( s \) believes herself to be an authority on \( p \). As a result, the inference drawn from \( F \) can be strengthened such that what \( a \) concludes from its utterance is that \( s \) does not believe \( p \).

\[
(21) \quad \text{Left Side PI strengthening} \\
(\neg B_s[p] \lor \neg B_s B_a[B_s[p] \Rightarrow p]) \land (B_s B_a[B_s[p] \Rightarrow p]) \models \neg B_s[p]
\]

Chemla’s account makes a further prediction, viz. that whenever it is clear that \( s \) believes \( p \), any PI regarding \( p \) will be strengthened on the right-side, i.e. the PI will be strengthened such that what is entailed is that \( s \) does not believe herself to be an authority on \( p \).

\[
(22) \quad \text{Right Side PI strengthening} \\
(\neg B_s[p] \lor \neg B_s B_a[B_s[p] \Rightarrow p]) \land B_s[p] \models \neg B_s B_a[B_s[p] \Rightarrow p]
\]

Chemla argues that the example in (23) provides evidence that right side strengthening does indeed appear where predicted. (23) competes with a presuppositionally stronger alternative, leading to the PI in (19). However in this utterance, \( s \) clearly states that she believes Mary is pregnant. Chemla’s account therefore predicts that from an utterance of (23), \( a \) will infer that \( s \) does not believe herself to be an authority on Mary being pregnant. Chemla claims that this is the intuitive reading one obtains from (23), but problems with this analysis will be discussed in section 3.1.

\[
(23) \quad \text{I believe that Mary is pregnant.} \\
\text{Predicted PI: } \neg B_s B_a[B_s[\text{that Mary is pregnant}] \Rightarrow \text{that Mary is pregnant}]
\]
2.3. *Maximize Presupposition! as Quantity* (Schlenker 2012)

Schlenker (2012) notes the parallel between the drawing of PIs from presuppositionally weak alternatives and the drawing of scalar implicatures within a neo-Gricean framework. He attempts to reduce MP as an independent principle to Gricean reasoning by proposing that the conversational principle according to which one must always use the presuppositionally stronger of two alternatives follows from the need to be as informative as possible. In other words, Schlenker proposes to reduce MP to Quantity, and as such reduce PIs to scalar implicatures.\(^6\)

Schlenker makes use of Chemla’s notion of authority to account for how presuppositions can be informative in a context where \(a\) does not believe \(p\). Assuming \(s\) to be an authority on \(p\), her uttering \(p\) will result in \(a\) believing \(p\). In such cases, presupposing \(p\) therefore seems to be a means of transmitting \(p\) as new information. Thus, in a context where \(s\) believes \(p\) and believes that she is an authority on \(p\), her using the weaker of two presuppositional alternatives can be interpreted as a violation of Quantity (Grice, 1975), as the presuppositionally stronger alternative would have been more informative. From the point of view of \(a\), the reasoning follows very closely that of scalar implicatures. Assume that \(a\) does not believe \(p\) but makes the AA. If \(s\) uses the presuppositionally weak \(F\) rather than its stronger alternative \(F'\), \(a\) will reason that if \(s\) believed \(p\), her failure to use \(F'\) would result in a violation of Quantity. Therefore \(a\) will infer that \(s\), who is taken to be cooperative, does not believe \(p\).\(^7\) Following Schlenker, one can propose a definition of *informativity* which states that an utterance \(F'\) is more informative than an utterance \(F\) whenever it is presuppositionally stronger than \(F\) or strictly entails \(F\).

\[
\text{(24) Informativity} \\
F' \text{ is more informative than } F, \text{ written as } F' \prec F, \text{ iff} \\
\{w \in W : F = \#\} \subset \{w \in W : F' = \#\} \text{ or } \{w \in W : F' = 1\} \subset \{w \in W : F = 1\}
\]

In order to propose a general pragmatic principle which equates PIs to scalar implicatures, it will also be necessary to extend the notions of *alternatives* and *appropriateness*. The first step in accomplishing this is to define a set of scales which includes not only presuppositional scales, but also scales relevant to scalar implicatures, in this case \(\langle \text{some, all} \rangle\) and \(\langle \text{or, and} \rangle\).

\[
\text{(25) Scales} \\
The set of scales } \Sigma = \{\langle a(n), \text{the} \rangle, \langle \text{all, both} \rangle, \langle \text{believe, know} \rangle, \langle \text{some, all} \rangle, \langle \text{or, and} \rangle\}
\]

---

\(^6\)Leahy (2016) pursues the same approach, but for reasons of space we confine attention to Schlenker’s execution of the idea.

\(^7\)As noted in the literature (Heim, 1991; Percus, 2006), MP does not hold only in situations where \(a\) is assumed to not believe \(p\), but crucially also holds when \(p\) is common belief prior to its presupposition by \(s\). To account for these cases, Schlenker introduces the idea that there exists parallel to any given common ground a weakened common ground where it is not common belief that \(p\), and this on account of the small chance that \(a\) will have forgotten \(p\). Through a mechanism Schlenker calls *recoverability*, such weakened common grounds can be updated following a presupposition of \(p\) by \(s\), ensuring that even when \(p\) is already common belief, it will be informative insofar as it updates the weakened common ground.
This extended set of scales can be used to define a set of alternatives which can therefore be used both for the computing of scalar implicatures as well as what has so far been assumed to be PIs.

(26) Alternatives

\[ F' \text{ is an alternative to } F, \text{ written as } \text{Alt}(F', F), \text{ iff } F' \text{ is identical to } F \text{ save for the substitution of one member of a scale in } \Sigma \text{ for another member of that same scale.} \]

Finally, we can extend the notion of appropriateness by stating that \( F' \) is appropriate if both its presupposed and assertive contents are believed by \( s \) and if \( s \) is an authority on both.

(27) Appropriateness

\[ F' \text{ is appropriate, written as } \text{App}(F'), \text{ iff for all } p \text{ presupposed or asserted by } F', \]
\[ B_s[p] \land B_a[B_s[p] \Rightarrow p] \]

With these notions in hand, we can now propose a general pragmatic principle, Be Informative! (BI), according to which speakers should not use some utterance \( F \) if there exists some \( F' \) which is an alternative to \( F \), more informative than \( F \) and appropriate.

(28) Be Informative!

A speaker \( s \) must not utter some \( F \) if there is an \( F' \) such that \( s \) believes that:

(i) \( \text{Alt}(F, F') \)
(ii) \( F' \lessdot F \)
(iii) \( \text{App}(F') \)

3. Authority and reliability

3.1. Problems With Authority

Let us for the moment set aside possible reductions of MP to Quantity and return to a framework where the two principles are disjoint. Consider once again Chemla’s prediction in (22), where he claims that in a sentence like (23), restated below, \( a \) will infer that \( s \) is not an authority on Mary being pregnant.

(23) I believe that Mary is pregnant.

Predicted PI: \( \neg B_s B_a [B_s [\text{that Mary is pregnant}] \Rightarrow \text{that Mary is pregnant}] \)

Chemla purports that what one intuitively gathers from (23) is that \( s \) is not an authority about Mary being pregnant, but it is not so clear that this is truly the inference one draws from that sentence. Recall that authority in its technical sense is defined as \( a \)'s willingness to accommodate a presupposition \( p \) if \( s \) believes \( p \). To say that (23) yields the inference that \( s \) does not believe she is an authority about Mary being pregnant implies that \( s \) does not believe that, had she presupposed that Mary is pregnant, \( a \) would not have accommodated this presupposition. This seems far too strong an inference for what one intuitively gathers from (23), viz. that \( s \) does not believe she is a reliable source of information regarding whether or not Mary is pregnant. In fact, the contrast between (29a) and (29b) may provide further evidence that the reliability
of the speaker is important to the computing of PIs. Consider the difference between the PI in (29a) and (29b).

(29) a. John believes that I have a sister.
    PI: $\neg B_s[that\ s\ has\ a\ sister]$

b. John believes that Mary has a sister.
    Unattested PI: $\neg B_s[that\ Mary\ has\ a\ sister]$

It is far from clear that from (29b) one can infer very much about $s$’s beliefs on whether or not Mary has a sister. Indeed, the contrast between the inference drawn from (29a) and that of (29b) can be made sharper if one considers whether or not it is acceptable for $a$ to question the inference. As noted by Marty (2017), PIs can be disputed using the *Hey, wait a minute!* test first discussed by von Fintel (2004). We report our judgments that while it is fine for $a$ to call into question $s$ having a sister following an utterance of (29a), it is odd for $a$ to question Mary having a sister following (29b). This may provide further evidence that the reliability of $s$ regarding the presupposition of an utterance’s alternative is important to whether or not one strengthens the PI. While in (29a) it seems reasonable to assume that $s$ is a reliable source of information regarding whether or not she has a sister, one assumes that in (29b), $s$ is not reliable regarding whether or not Mary has one.8

(30) a. $s$: John believes that I have a sister.
    $a$: Hey, wait a minute! You don’t have a sister?

b. $s$: John believes that Mary has a sister.
    $a$: #Hey, wait a minute! Mary doesn’t have a sister?

There is in fact good reason to believe that defining presuppositional appropriateness in terms of $s$’s beliefs on $p$ and on whether she is an authority on $p$ provides an account of MP which is much too strong. Consider once again the examples in (11-13), and consider the failure of the *Hey, wait a minute!* test on these.

(31) a. $s$: John is looking for the number of a girl he met in Berlin.
    $a$: #Hey, wait a minute! John met more than one girl in Berlin?

b. $s$: All of the papers Mary submitted were rejected.
    $a$: #Hey, wait a minute! Mary submitted more than two papers?

c. $s$: John believes Mary is pregnant.
    $a$: #Hey, wait a minute! Mary isn’t pregnant?

Compare these results with those we obtain when considering the examples in (14-15).

(32) a. $s$: A bathroom in my apartment is flooded.
    $a$: Hey, wait a minute! There’s more than one bathroom in your apartment?

---

8In fact, the strong inference derived from (29a) does not appear in contexts where $s$ is not reliable on whether she has a sister. Consider its utterance in a context where $s$ is an orphan, and has been told by some acquaintance that he recalls her adoption papers mentioning that $s$ had a sister. Here, one would not draw from (29a) the inference that $s$ does not believe she has a sister.
b. \(s\): All of my brothers fought in Vietnam.

\(a\): Hey, wait a minute! You have more than two brothers?

For Chemla’s account of PIs to not predict strengthened PIs from the utterances in (11-13), it would have to be the case that for each of these, the AA is not made by \(a\). But this is once again a highly questionable premise as there is no question that, barring disagreement, \(a\) would accommodate the presuppositions of the stronger alternatives of each of these sentences. Why then would \(a\) not assume that \(s\) believes herself to be an authority on these presuppositions? To argue that this is what one concludes from the data would be to set the stage for a circular argument, and what one wants here is not to simply state the facts, but to offer an explanation for them. What seems necessary is to strengthen our notion of presuppositional appropriateness so as to weaken our PIs. As noted above, \(s\)’s reliability seems to play an important role regarding whether or not PIs are strengthened, and would thus serve as a good candidate to strengthen appropriateness. Of course, even when \(s\) is unreliable regarding some \(p\), if \(a\) already believes \(p\), then it will be appropriate for \(s\) to presuppose \(p\) so long as \(s\) also believes \(p\). Hence, presuppositional appropriateness can be strengthened in (33) by adding to its definition that it must either be the case that \(s\) is reliable about \(p\) or that \(a\) already believes \(p\).

\[
(33) \quad \text{Presuppositional appropriateness}
\]

\[
\text{App}_{s}(F') \iff \text{for all } p \text{ presupposed by } F', B_{s}[p] \land B_{a}[B_{s}[p] \Rightarrow p] \land (B_{a}[p] \lor \text{Rel}(s, p)),
\]

where \(\text{Rel}(s, p)\) is to be read as ‘\(s\) is reliable about \(p\)’.

Trivially, whenever \(a\) already believes \(p\), it follows that \(s\) is an authority on \(p\). From this, it is easy to see that for \(s\) to be an authority on \(p\) and for \(a\) to already believe \(p\) is equivalent to simply saying that \(a\) believes \(p\). From this result, we can show that our definition of presuppositional appropriateness is equivalent to the one in (34)

\[
(34) \quad \text{Presuppositional appropriateness (equivalent formula)}
\]

\[
B_{s}[p] \land (B_{a}[p] \lor (B_{a}[B_{s}[p] \Rightarrow p] \land \text{Rel}(s, p))
\]

Now imagine that \(s\) is not reliable with respect to some presupposition \(p\). In such a situation, it follows that \((B_{a}[B_{s}[p] \Rightarrow p] \land \text{Rel}(s, p))\) is false, in which case, \((B_{a}[p] \lor (B_{a}[B_{s}[p] \Rightarrow p] \land \text{Rel}(s, p))\) is equivalent to simply \(B_{a}[p]\). In such contexts, a presupposition would be appropriate only when both \(s\) and \(a\) believe \(p\).

\[
(35) \quad \text{Presuppositional appropriateness (when } s \text{ is not reliable on } p)
\]

\[
B_{s}[p] \land B_{a}[p]
\]

\(^9\)See Rouillard and Schwarz (2017) for arguments that surprisal and even speaker efficiency also play a role in determining whether a presupposition is appropriate. What seems plausible is that appropriateness should be strengthened by the conjunction of a series of disjuncts, among which would be reliability, the addressee’s beliefs in \(p\), surprisal and efficiency. For the sake of simplicity and clarity, we assume here only reliability and the addressee’s belief.

\(^{10}\)This can be shown by the following reasoning:

\[
B_{s}[p] \land (B_{a}[B_{s}[p] \Rightarrow p] \land (B_{a}[p] \lor \text{Rel}(s, p))) \equiv
\]

\[
B_{s}[p] \land ((B_{a}[B_{s}[p] \Rightarrow p] \land B_{a}[p]) \lor (B_{a}[B_{s}[p] \Rightarrow p] \land \text{Rel}(s, p))) \equiv
\]

\[
B_{s}[p] \land (B_{a}[p] \lor (B_{a}[B_{s}[p] \Rightarrow p] \land \text{Rel}(s, p)))
\]
Assuming that \( s \) is not reliable with respect to \( p \) in (11-13), we predict the PI for each of these utterances to be the formula in (36).

\[
\neg B_s[p] \lor \neg B_sB_a[p]
\]

(36) Presuppositional Implicature (when \( s \) is not reliable on \( p \))

3.2. Presuppositional implicatures from Quantity? Comparing Predictions

Let us now return to the reduction of MP to Quantity discussed in section 2.3. Much like the version of MP in section 2.2, this account relies heavily on \textit{authority} in order to show how presuppositions could be used to update contexts. As discussed, this will run into problems when considering the examples in (11-13) as, barring disagreement, it is hard to imagine why \( s \) would ever use the weaker alternative of some \( F' \) presupposing \( p \). Consider the vantage point of \( a \) for any of these utterances when assuming that speakers are expected to obey BI as stated in (28). Assuming \( a \) does not already believe \( p \) (but does not believe \( p \) to be false), \( a \) will reason following these utterances that there exists for each of them a more informative alternative \( F' \). From this, \( a \) will infer that either \( s \) does not believe the presuppositions of \( F' \) or does not believe herself to be an authority on them. As discussed earlier, there is no reason for \( a \) not to make the AA, as it is a matter of common sense that she would have accommodated the presuppositions, in which case the inferences predicted from (11-13) will be that \( s \) does not believe the presuppositions of their alternatives. As discussed above, these predictions are inaccurate. A natural move to make here would be to amend appropriateness in BI in the same way it was amended for MP in section 3.1, viz. by restricting appropriateness with the disjunction of reliability and addressee belief in \( p \).

\[
\text{App}(F') \iff \text{for all } p \text{ presupposed or asserted by } F', \\
B_s[p] \land B_a[B_s[p] \Rightarrow p] \land (B_a[p] \lor \text{Rel}(s,p))
\]

(37) Appropriateness

However, it is easy to see that such a formulation of appropriateness is far too strong. Consider once again the utterance in (29b), stated in (38a), as well as the very similar utterance in (38b).

\[
\text{a. John believes that Mary has a sister.} \\
\text{b. John believes that Jane has a sister.}
\]

(38) a. John believes that Mary has a sister. \\
b. John believes that Jane has a sister.

We assume that in each of these cases, the weak PIs obtained are the result of \( s \) being unreliable with respect to the presuppositions of their alternatives, \textit{i.e.} \( s \) is unreliable on Mary having a sister and unreliable on Jane having a sister. But now consider the example in (39a) in a context where \( a \) does not know about whether Mary or Jane have siblings, which competes with the alternative in (39b).

\[
\text{a. Mary has a sister or Jane has a sister.} \\
\text{Inference: } \neg B_s[\text{Mary has a sister and Jane has a sister}] \\
b. Mary has a sister and Jane has a sister.
\]

(39) a. Mary has a sister or Jane has a sister. \\
b. Mary has a sister and Jane has a sister.
Given our assumption that \( s \) is not reliable on Mary having a sister and Jane having a sister, one would predict for (39a) an inference on par with that in (36). That is, one would predict from (39a) the inference in (40).

\[
(40) \quad \neg B_s[\text{that Mary has a sister and Jane has a sister}] \lor \neg B_a[\text{that Mary has a sister and Jane has a sister}]
\]

This is of course not what one intuitively gathers from (39a), from which speakers infer (in addition to ignorance inferences) that it is not the case that both Mary and Jane have a sister. One could attempt a further restriction on appropriateness such that it applies solely to presuppositions, as in (41).

\[
(41) \quad \text{Appriateness}
\]

\[
\text{App}(F') \iff \text{for all } p \text{ presupposed or asserted by } F',
\]

\[
B_s[p] \land B_a[B_s[p] \Rightarrow p] \land
\]

\[
\text{for all } q \text{ such that } q \text{ is presupposed,}
\]

\[
B_a[q] \lor \text{Rel}(s, q)
\]

Such a notion of appropriateness, however, runs into an important conceptual problem if one tries to reconcile it with treating presuppositions as informative. Consider once more a context in which \( s \) is not reliable on some presupposed \( p \). The notion of appropriateness when considering the presupposition \( p \) will be the one in (35), restated below.

\[
(42) \quad \text{Appriateness (when } s \text{ is not reliable on } p)
\]

\[
B_s[p] \land B_a[p]
\]

This suggests that, were \( s \) to believe \( p \) to be true but not believe that \( a \) takes \( p \) for granted, presupposing \( p \) would be judged inappropriate by \( s \). For \( s \) to judge \( p \) to be inappropriate on account of \( a \) not already knowing \( p \) seems to run counter to the idea that presuppositions are to be understood as vectors of new information. The question becomes how to maintain the distinction between (29a) and (29b), where (29a) seems to generate an inference similar to a scalar implicature while (29b) does not, while nevertheless preventing appropriateness from taking the form in (42). One solution is to remove any mention of \( a \)'s beliefs from the conditions on presuppositional appropriateness. That is, rather than have these conditions be the disjunction \((B_a[p] \lor \text{Rel}(s, p))\), these can be simply stated as \(\text{Rel}(s, p)\). This would however appear to be too strong a notion of appropriateness. Indeed, this would predict that it is inappropriate for \( s \) to ever presuppose some proposition \( p \) on which \( s \) is not a reliable source of information. We know, however, that \( p \) will always be appropriate when it is already taken for granted by both conversational partners, and this irrespective of whether or not \( s \) is reliable on \( p \). Faced with such a problem, it would appear that modifying the notion of appropriateness is incompatible with an account of MP which treats presuppositions as informative. The soundest move from here would be to redefine our notion of informativity. That is, we will assume that unless \( s \) is reliable on \( p \), \( p \) cannot be informatively used as a presupposition.
Informativity
\[ F' \prec F \iff \]

(i) \[ \{ w \in W : F = # \} \subset \{ w \in W : F' = # \} \] or \[ \{ w \in W : F' = 1 \} \subset \{ w \in W : F = 1 \} \]

(ii) For every \( p \) presupposed by an utterance of \( F' \), \( \text{Rel}(s, p) \)

Let us now assess what predictions our amended version of BI makes when \( s \) utters the weaker of two alternatives \( F \) such that \( s \) is not reliable on the presupposition \( p \) of the stronger alternative \( F' \). Given that \( s \) is not reliable on \( p \), it will follow from our definition of informativity that \( F' \) is not more informative than \( F \). As a result, \( s \) is not expected to use the stronger alternative and, thus, no inference is predicted from her utterance of \( F \). We now have a clear difference in the predictions of MP as an independent principle and BI. When \( s \) is unreliable on the presupposition \( p \) of \( F' \), MP predicts that an utterance of \( F \) will generate the inference in (44). On the other hand, BI predicts that no inference will be generated from such an utterance.

(44) \[ \neg B_s[p] \lor \neg B_a B_s[p] \]

Of course, the inference in (44) is extremely weak, and it is unclear whether one could ever report perceiving such an inference from the utterance of some weak presuppositional alternative. However, following Chemla’s idea of an epistemic step for MP, we can verify whether this disjunctive inference is strengthened in contexts where \( a \) assumes one of the disjuncts to be false. For instance, if \( a \) assumes \( s \) to believe that \( p \), an utterance by \( s \) of some weak \( F \) competing with an \( F' \) presupposing some \( p \) (for which \( s \) is unreliable) will be predicted to yield the inference in (44) which, given \( a \)’s beliefs, will be strengthened to simply \( \neg B_s B_a[p] \). To test this, consider an utterance of (11), within a context where \( a \) knows that John met exactly one girl in Berlin and is certain that \( s \) is also aware of this.

(45) \( s \): John is looking for the number of a girl he met in Berlin.
\( a \): Hey, wait a minute! A girl he met in Berlin? We both know he met one girl there.

The same test can be applied to (12) and (13). In (12), we assume \( a \) to be certain about \( s \) knowing that Mary submitted exactly two papers while in (13), \( a \) is certain about \( s \) knowing that Mary is pregnant.

(46) \( s \): All of the papers Mary submitted were rejected.
\( a \): Hey, wait a minute! All of the papers Mary submitted? We both know she submitted two.

(47) \( s \): John believes that Mary is pregnant
\( a \): Hey, wait a minute! John believes that Mary is pregnant? We both know that she is.

\(^{11}\)We require that \( a \) be certain that \( s \) is aware of this fact in order to prevent \( a \) from revising her beliefs on \( s \)’s belief that John met exactly one girl in Berlin.
Clearer judgments are perceptible when (44) is strengthened by assuming the right-hand disjunct is false. This can be achieved by having a assert (or presuppose) \( p \), only to have s respond to a by using the weaker \( F \) rather than the presuppositionally stronger \( F' \). In this case, we predict the inference in (44) to be strengthened such that what is inferred is that s does not believes \( p \), \( \neg B_s[p] \).

\[
(48) \quad \begin{align*}
\text{a.} & \quad a: \text{Is John looking for the number of the girl he met in Berlin?} \\
& \quad s: \text{John is looking for the number of a girl he met in Berlin.}
\text{b.} & \quad a: \text{Whatever happened to the two papers Mary submitted?} \\
& \quad s: \text{All of the papers Mary submitted were rejected.}
\text{c.} & \quad a: \text{Did you hear the news from John? He just told me Mary is pregnant.} \\
& \quad s: \text{John believes that Mary is pregnant.}
\end{align*}
\]

In all of these cases, s’s avoidance of the presuppositionally stronger alternative generates the predicted inference. Crucially, this is not predicted from BI, as the presupposition of the alternative is not taken to be informative on account of s’s lack of reliability.

4. Conclusion

This paper argues that a challenge to attempts at reducing presuppositional implicatures to scalar implicatures arises once it is recognized that authority in and of itself is insufficient to account for such inferences. Indeed, a principle such as BI, even when enriched by the notion of reliability, does not predict weak inferences from the utterances in (11-13). On the other hand, a principle such as MP independent of notions of informativity seems not only able to predict these inferences, but moreover predicts the epistemic strengthening operated on examples (14-16). It would appear as though the imperative to presuppose as much as possible is not fully explicable in terms of informativity. Rather, speakers must sometimes reason not only about what is accommodatable in the common ground, but also about what is common ground prior to their utterances. That is, speakers are not expected to use presuppositions for which they are not reliable unless these are already taken for granted by them and their addressee.

Appendix

The modern Stalnakerian view of presupposition and common ground argues that a presupposition is appropriate if it becomes common belief after its utterance that \( p \). To this effect, Schlenker (2012) assumes that when s presupposes \( p \), it becomes common belief that s believes \( p \) will be common belief at some time \( t \) at which a checks the presupposition \( p \). With this in mind, he proves that at \( t \), if \( CB_sC[p] \) is true and a has indeed accommodated \( p \ (B_a[p]) \), it follows that \( C[p] \). We show here that the definition of presuppositional appropriateness in (18) paired with the assumption that s is an authority on \( p \) will be sufficient to ensure that \( p \) is common belief after it is presupposed by s, thus deriving the results of Schlenker’s proof without the need to assume that s presupposing \( p \) leads to inferences about s’s beliefs on the future. In order to prove this, we must first introduce the lemma in (49).
Lemma 1
\( \forall i [B_i[p] \iff B_i B_i[p]] \)

We follow Stalnaker (2002) in assuming that beliefs are represented by an accessibility relation \( R_i \) such that \( B_i[p] \) is true if and only if for all worlds satisfying \( w R_i w' \), \( p \) is true in \( w' \). We further assume that \( R_i \) is transitive, euclidean and serial.\(^{12}\)

(50) a. Transitivity: \( \forall w \forall w' \forall w'' [w R_i w' \land w R_i w'' \Rightarrow w R_i w'''] \)
b. Euclideanity: \( \forall w \forall w' \forall w'' [w R_i w' \land w R_i w'' \Rightarrow w R_i w'''] \)
c. Seriality: \( \forall w \exists w' [w R_i w'] \)

Assume that \( B_i[p] \) is true in \( w \). Then \( p \) is true in all worlds \( w' \) satisfying \( w R_i w' \). By transitivity, it follows that all worlds \( w'' \) satisfying \( w R_i w'' \) also satisfy \( w R_i w''' \), and thus that \( p \) is true in all such worlds. From this, we can conclude that in all \( w' \) satisfying \( w R_i w' \), \( B_i[p] \) is true, and thus it must be the case that \( B_i B_i[p] \) is true in \( w \). In other words, for all \( i \), if \( B_i[p] \), then \( B_i B_i[p] \).

Assume that \( B_i B_i[p] \) is true in the world of evaluation \( w \) for some arbitrary \( i \). Then, for all worlds \( w' \) satisfying \( w R_i w' \), it will be the case that \( B_i[p] \), and in all worlds \( w'' \) satisfying \( w R_i w'' \), it will be the case that \( p \). Given that \( R_i \) is transitive, it follows that all worlds \( w''' \) satisfying \( w R_i w''' \) also satisfy \( w R_i w'' \). Hence in all such worlds \( B_i[p] \) holds. Given euclideanity, all worlds \( w' \) satisfying \( w R_i w' \) must also satisfy \( w'' R_i w''' \), and hence in all such worlds it must be the case that \( p \). Thus, in all worlds \( w' \) satisfying \( w R_i w' \), it must be the case that \( p \), and therefore it must be the case that \( B_i[p] \) in \( w \). This in turn entails that if \( B_i B_i[p] \) is true in \( w \), then so is \( B_i[p] \).

Having shown that for all \( i \), if \( B_i[p] \), then \( B_i B_i[p] \) and if \( B_i B_i[p] \), then \( B_i[p] \), we conclude that for all \( i \), \( B_i[p] \) is true if and only if \( B_i B_i[p] \). QED

The second lemma we introduce will be that whenever the common ground entails that it is common belief that \( B_s[p] \) and it is common belief that \( B_o[p] \), it will be common belief that \( p \).

(51) Lemma 2
If
(i) \( CB_s[p] \)
(ii) \( CB_o[p] \)
then
(iii) \( C[p] \)

Assume that both \( CB_s[p] \) and \( CB_o[p] \) are true.

\( C[p] \) is true according to our definition of common belief in (4) if and only if for all \( B \) in the set \( \mathcal{B} \), \( B[p] \) is true. This entails on the one hand that both \( B_s[p] \) and \( B_o[p] \) are true and on the other that for any sequence \( S \) of two or more belief operators, \( S[p] \) is also true.

\(^{12}\)While seriality is not essential to our proofs, it does simplify them by allowing us to disregard all cases where there is no \( w' \) satisfying \( w R_i w' \).
If $CB_s[p]$, then it follows by our definition of common belief that $B_s[B_s[p]]$. We can conclude from (49) that because $B_s[B_s[p]]$, then $B_s[p]$. Hence, it follows from $CB_s[p]$ that $B_s[p]$. If $CB_a[p]$, then it will be the case that $B_a[B_a[p]]$ according to our definition of common belief, and from (49) we can conclude that $B_a[p]$. It therefore follows that if $CB_s[p]$ and $CB_a[p]$, then $B_s[p]$ and $B_a[p]$.

Let $S$ be an arbitrarily chosen sequence of two or more belief operators from $\mathcal{B}$. Then it is either the case that $S$ ends in $B_s$, or in $B_a$.

Case 1: Assume $S$ ends in $B_s$. Then $S$ can be represented as the concatenation $S'B_s$ of some non-empty sub-sequence $S'$ of $S$ and $B_s$. Clearly, $S'$ is a sequence of at least one belief operator. Given our assumption that $CB_s[p]$, it follows by our definition of common belief that $S'B_s[p]$ is true, and thus that $S[p]$ is also true.

Case 2: Assume $S$ ends in $B_a$. Then once again $S$ is the concatenation $S'B_a$ of some non-empty sub-sequence $S'$ and $B_a$. Once again, $S'$ is a sequence of belief operators and thus it follows from our assumption that $CB_a[p]$ that $S'B_a[p]$, and therefore that $S[p]$.

We can conclude from this that for any sequence $S$ of two or more operators, $S[p]$ holds if both $CB_s[p]$ and $CB_a[p]$ do. This in addition to the fact that $B_s[p]$ and $B_a[p]$ follow from $CB_s[p]$ and $CB_a[p]$ allows us to conclude that if $CB_s[p]$ and $CB_a[p]$ are true, then for all $B \in \mathcal{B}$, $B[p]$ is true. This in turn entails by our definition of common belief in (4) that $C[p]$ is also true. QED

Following Stalnaker (2002), we assume that $s$’s speech act of presupposing $p$ is a manifest event, i.e., an event which ensures that after it occurs it will be common belief that it has occurred. Hence, when $s$ presupposes $p$, it becomes common belief that $s$ believes $p$ is appropriate, or equivalently, it becomes common belief that $s$ believes $p$ and common belief that $s$ believes she is an authority on $p$.

(52) \[ CB_s[p] \land CB_a[B_s[p] \Rightarrow p] \]

Let us assume that $s$ presupposes $p$ at some time $t$. As a result of this speech act, it becomes common belief at $t+1$ that $s$ believes that it is appropriate to presuppose $p$, in which case it follows that (52) is true. If $s$ is in fact an authority on $p$, i.e., if $a$ is willing to accommodate $p$ when $s$ believes $p$, then it follows that $p$ is common belief.

(53) \[ \text{If} \]

(i) \[ CB_s[p] \]

(ii) \[ CB_a[B_s[p] \Rightarrow p] \]

(iii) \[ B_a[B_s[p] \Rightarrow p] \]

then

(iv) \[ C[p] \]

Assume that $CB_s[p]$, $CB_a[B_s[p] \Rightarrow p]$ and $B_a[B_s[p] \Rightarrow p]$ are all true.
Consider all possible sequences of members of $\mathcal{B}$ that can precede $B_a$ in $CB_a[p]$. $B_a$ can be preceded by a sequence with only instances of $B_s$, a sequence with only instances of $B_a$, or a sequence $S$ containing both instances of $B_s$ and $B_a$.

**Case 1:** Let $B^n_a$ be a sequence of $n$ instances of $B_s$, where $n \in \mathbb{N}$. Given that $CB_s[B_s[p] \Rightarrow p]$, it follows that $B_sB_a[B_s[p] \Rightarrow p]$ is true, which by (49) entails that $B_sB_a[B_s[p] \Rightarrow p]$. Given that $CB_s[p]$, it follows that $B_sB_a[B_s[p] \Rightarrow p]$ and $B_sB_a[B_s[p] \Rightarrow p]$ together allow us to conclude that $B_sB_a[p]$, which we can rewrite as $B'_sB_a[p]$. Now let there be some arbitrary $m \in \mathbb{N}$ such that $B^{n+m}_sB_a[p]$ is true. By (49), it follows that $B^{n+1}_sB_a[p]$, in which case we can conclude by mathematical induction that for all $m \in \mathbb{N}$, $B^{n+m}_sB_a[p]$, and hence we conclude that $B^n_sB_a[p]$ is true.

**Case 2:** Let $B^n_a$ be a sequence of $n$ instances of $B_s$, where $n \in \mathbb{N}$. Given that $CB_s[p]$, we know that $B_sB_a[p]$. Paired with our assumption that $B_a[B_s[p] \Rightarrow p]$, this entails that $B_a[p]$. Through the same reasoning as in Case 1, it follows that for all $n \in \mathbb{N}$, $B^n_a[p]$ is true.

**Case 3:** Let $S$ be a sequence of $B_s$ and $B_a$. Then either $S$ is the concatenation $S'B^1_sB^n_a$ of some (possibly empty) sub-sequence $S'$ of $S$, one instance of $B_s$, and some arbitrary sequence of $n$ instances of $B_s$, where $n \in \mathbb{N}$, or $S$ is the concatenation $S'B^1_sB^n_a$, where $n \in \mathbb{N}$.

**Case 3.1:** Assume $S$ is the concatenation $S'B^1_sB^n_a$. Given our assumption that $CB_sB_a[B_s[p] \Rightarrow p]$ is true, it follows that $S'B^1_sB^n_aB_a[B_s[p] \Rightarrow p]$. Likewise, given that $CB_s[p]$ is true, so must be $S'B^1_sB^n_aB_sB_a[p]$. Together, these entail that $S'B^1_sB^n_aB_a[p]$, or equivalently that $S'B^1_sB^n_aB_a[p]$.

**Case 3.2:** Assume $S$ is the concatenation $S'B^1_sB^n_a$. Given that $CB_sB_a[B_s[p] \Rightarrow p]$ is true, so must be $S'B_sB_a[B_s[p] \Rightarrow p]$, which by (49) is equivalent to $S'B_sB_a[B_s[p] \Rightarrow p]$. Given that $CB_s[p]$ is true, it follows that $S'B_sB_a[p]$ is also true. Together, these entail that $S'B_sB_a[p]$, which can be rewritten as $S'B^1_sB_a[p]$. Assume that $S'B^1_sB_a[p]$ is true for some arbitrarily chosen $m$ such that $m \in \mathbb{N}$. Given (49), it follows that $S'B^1_sB^{m+1}_a[p]$, and thus by mathematical induction, for all $m \in \mathbb{N}$, $S'B^1_sB^{m+1}_a[p]$ is true. We can thus conclude that $S'B^1_sB^{n+1}_a[p]$ is true, or in other words, that $S'B^1_sB^n_a[p]$ is true.

We see that for any sequence $S$ of members of $\mathcal{B}$, $SB_a[p]$ is true, and thus by our definition of common belief, $CB_a[p]$ must be true. Since both $CB_s[p]$ and $CB_a[p]$ are true, by (51) it follows that $C[p]$. QED

An important point noted by Chemla is that in case of a disagreement on a given proposition $p$, it will not be the case that $s$ is an authority on $p$. We let the reader convince herself that if $s$ is not an authority on $p$, it will not be the case that an utterance of $p$ by $s$ will make $p$ common belief. A further point to note is the fact that in cases where $a$ already believes $p$, $s$’s authority on $p$ is trivially met. Here too we let the reader convince herself that if $a$ already believes $p$ at the moment of its utterance by $s$, $p$ will be common belief following this utterance.
References


The semantics of Turkish numeral constructions
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Abstract. This paper explores Turkish numeral constructions, which have typologically two interesting properties: (i) the existence of an optional classifier, (ii) the incompatibility of plurals with them. I argue that numerals are modifiers of type \(<e,t>,<e,t>\) defined only for atomic properties (Ionin and Matushansky 2006). The explanation rests on the semantics of bare singulars proposed to denote sets of atoms (contra Bale et al. 2010), and the semantics of the classifier claimed to be a partial identity function presupposing atomic properties.

Keywords: numerals, atomicity, number neutrality, plurality, kinds, optional classifiers.

1. Introduction

Turkish numeral constructions have two typologically interesting properties: (i) the existence of an optional classifier, \(tane\), and (ii) the incompatibility of plurals with them as shown in (1a) and (1b) below.

\[
\begin{align*}
(1) & \quad \text{a.} \quad \text{iki (tane) kitap} \quad \text{b.} \quad \text{*iki (tane) kitap-lar} \\
& \quad \text{two CL book} \quad \text{two CL book-PL} \\
& \quad \text{‘two books’} \quad \text{‘two books’}
\end{align*}
\]

This paper argues that Turkish numerals are modifiers of type \(<e,t>,<e,t>\) that combine with atomic properties as proposed by Ionin and Matushansky (2006), contra Bale et al. (2010) where they are treated as restrictive modifiers. The analysis revolves around the semantics of bare singulars which are proposed to denote sets of atoms here instead of being number neutral as claimed in Bale et al. (2010). In addition, the classifier \(tane\) is claimed to be a partial identity function presupposing atomic properties.

Notes on terminology: I refer to nouns unmarked for number as bare singulars, whereas I refer to nouns inflected with \(-\text{lar}\) as bare plurals following the convention in Carlson (1977) and neo-Carlsonian studies for English bare plurals. As stated above, this paper shows that singularity of bare singulars is not only a morphological but also a semantic property contrasting with the accounts positing a number neutral denotation to them. Since Turkish lacks an overt definite article, both bare singulars and bare plurals can freely occupy argument positions, as opposed to English in which bare singulars do not have this freedom.

This paper is organized as follows. Section 2 introduces two distinct accounts of the semantics

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1I am indebted to Veneeta Dayal, Simon Charlow and Mark Baker for their generous comments on this work. I also thank Ömer Demirok, Jess Law, Lucas Champollion, and Haoze Li for helpful discussions.

2Turkish has two classifiers besides group denoting ones. One is \(tane\), compatible with all count nouns, and the other is \(adet\), compatible with non-human count nouns. In this study, I will only refer to \(tane\) since the distribution of both classifiers is the same. They are considered to be classifiers since they have similar properties as the classifiers in other languages. As defined in Kim (2009), (i) classifiers are only compatible with count nouns whereas measure words are compatible with both count and mass nouns, (ii) they cannot be modified by an adjective as opposed to measure words, and (iii) they can be used with quantifiers compatible with count nouns.

of Turkish numerals and clarifies the relevant details. Section 3 provides an analysis for the semantics of bare singulars showing that they denote atomic properties. Section 4 incorporates the optional classifier tane into the overall picture. Section 5 concludes.

2. The Semantics of Numerals

Numerals have been treated as both determiners of type \(<<e,t>,<<e,t>,t>>\) (Bennett 1974, among others) and predicates of type \(<e,t>\) (Partee 1987, Link 1987, Landman 1989, among others). Among the ones who treat numerals as predicates, Link (1987) analyzes them as restrictive modifiers. However, all of these works focus only on simplex numerals. On the other hand, Ionin and Matushansky (2006) (I&M, henceforth) treat numerals as modifiers of type \(<<e,t>,<e,t>>\) the lexical complement of which has to be atomic. Their illustration is given in (2) (pg. 321). Informally, \([two\ books]\) can be stated as in (3).

(2) a. \([two] = \lambda P \lambda x \exists S [\prod (S)(x) \land |S| = 2 \land \forall s \in S P(s)]\)

b. \(\prod (S)(x) = 1\) iff

\(S\ is\ a\ cover\ of\ x,\ and\)

\(\forall z, y \in S [z = y \lor \neg \exists a [a \leq z \land a \leq y]]\)

c. A set of individuals \(C\) is a cover of a plural individual \(X\) iff \(X\) is the sum of all members of \(C\): \(\sqcup C = X\)

(3) \(\lambda x \in D_e. \ x\ is\ a\ plural\ individual\ divisible\ into\ 2\ non-overlapping\ individuals\ \(p_i\)\ such\ that\ their\ sum\ is\ \(x\)\ and\ each\ \(p_i\)\ is\ a\ book.\)

I&M show that if simplex numerals were determiners it would not be possible to derive the semantics of complex numerals, like \(two\ hundred\). Namely, if \(hundred\) (presumably of type \(<<e,t>,<<e,t>,t>>\)) combined with \(books\) (of type \(<e,t>\)) first, the resulting NP would be a generalized quantifier of type \(<<e,t>,t>>\). Consequently, this NP could not combine with another numeral. They also show that treating numerals as predicates of type \(<e,t>\) faces the same problem; the semantic composition of numerals would fail in a complex numeral construction. This time, the problem is not about types, but predicate modification would result in incorrect truth-conditions. Namely, the NP \(two\ hundred\ books\) would denote the empty set since for no \(x\) it is the case that the set of atoms is equal to both two and hundred simultaneously.

On the other hand, in I&M’s analysis complex numerals are derived fully compositionally, i.e. \(hundred\ books\) being of type \(<e,t>\) can be an argument to \(two\) that is of type \(<<e,t>,<e,t>>\).

The crucial part of their claim is that they treat English -s in numeral constructions as number agreement (semantic concord) rather than being a genuine plural marker. They claim that true plurals cannot combine with numerals because a plural noun such as \(books\) denotes a set of individuals \(x\), where each \(x\) is a plurality of books, and these pluralities do not necessarily have the same cardinality. In other words, \(books\ in\ two\ books\) has to be semantically singular, only denoting a set of atomic individuals.

There are two main approaches to Turkish numerals. One is I&M’s (2006) view of numerals
as sketched above. They claim that languages like Turkish, where numerals combine with singular forms of nouns, constitute evidence for the atomic requirement of numerals. Their claim is based on the assumption that Turkish bare singulars denote sets of atoms.

On the other hand, Bale et al. (2010) argue against this view and treat Turkish numerals as restrictive modifiers combining with nouns via subsective modification, following Link (1987). Namely, numerals in Turkish are considered as functions from number neutral sets to one of their subsets which consists of all and only the groups that are composed of n (number denoted by the numeral) non-overlapping (atomic) minimal parts. The idea is that Turkish bare singulars are number neutral, i.e. inclusive of atoms and their pluralities, instead of denoting sets of atoms. Their semantics of Turkish numerals is illustrated below (Bale et al. 2010: pg. 10):

\[
\begin{align*}
(4) & \quad \text{a. } [\text{two}] = \lambda P_{pl} \lambda P_{pl} \lambda x \lambda Y \lambda z \left[ x \in P_{pl} & \land Y \subseteq \text{PART}(x) & \land \exists z \left( z \in Y \rightarrow z \in \text{MIN}(P_{pl}) \right) \right] \\
& \quad \text{b. A predicate } Q \text{ is of type } P_{pl} \iff \forall x, y \in Q \left[ x \oplus y \in Q \right] \\
& \quad \text{c. } \text{MIN}(P) \text{ is defined iff} \\
& \quad \forall x, y \left[ x, y \in P & \land \exists z \left[ z \in P & \land \left[ z < y \lor z < x \right] \rightarrow x \land y = 0 \right] \right].
\end{align*}
\]

In this paper, I aim at showing that I&M’s analysis should be favored over Bale et al.’s. Adopting this view of numerals explains the core facts of Turkish numeral constructions if the following hold: (i) Turkish bare singulars are strict singulars denoting sets of atoms, (ii) Turkish numeral constructions lack plural agreement, and (iii) the classifier 
\text{tane} is a partial identity function defined only for atomic properties. Following I&M in that Turkish numeral constructions lack plural agreement unlike the English ones, I will motivate and justify the atomicity of bare singulars and the semantics of the classifier below.

3. Turkish Bare Singulars as Atomic Properties

Thanks to the seminal work of Link (1983), the mereological treatment of pluralities has become a well-established tradition in the semantic literature, where the domain of individuals \((D_x)\) has been assumed to include atoms and their closure under the sum operator \(\oplus\). For example, the complete atomic join semilattice with a, b, and c as singular individuals include the atoms a, b, c and the pluralities a \(\oplus\) b, a \(\oplus\) c, b \(\oplus\) c, and a \(\oplus\) b \(\oplus\) c.

Bale et al. (2010) argue that Turkish bare singulars denote number neutral sets, inclusive of atoms and pluralities (see also Görgülü 2012). For example, if in a model a, b, and c are the books, the Turkish noun \text{kitap} ‘book’ denotes the set \(\{a, b, c, a \oplus b, a \oplus c, b \oplus c, a \oplus b \oplus c\}\). Their claim is based on the neutral interpretation of bare singulars in the predicate position as in (5a). In addition, bare singulars in Turkish are also known as having neutral interpretations in non-case marked direct object positions as exemplified in (5b).

\[
\begin{align*}
(5) & \quad \text{a. } \text{Ali ve Merve } \text{c} \text{\c o} \text{\c u} \text{k} \text{.} \\
& \quad \text{b. } \text{Ali } \text{kitap } \text{o} \text{\k u} \text{-d} \text{u.} \\
& \quad \text{\text{\q u\\l i and Merve child} } \\
& \quad \text{‘Ali and Merve are children.’} \\
& \quad \text{\text{\q u\\l i book read-PAST} } \\
& \quad \text{‘Ali read a book/books.’}
\end{align*}
\]
Despite what these cases seem to suggest, I argue that bare singulars in Turkish denote sets of atoms only, i.e. $\{a, b, c\}$. My claim is based on their singularity in argument positions and their singular kind denotations. I will first illustrate the strict singularity of bare singulars and then explain the apparent number neutrality in the cases shown above, which I claim to follow from their singular kind denotations.

3.1. Strict singularity in argument positions

Bare singulars in Turkish are interpreted as strictly singular and definite in subject and case-marked object positions as shown in (6a) and (6b), respectively. This constitutes evidence for their atomicity. Namely, if they denoted number neutral sets inclusive of atoms and pluralities, we would expect to get number neutral interpretations in these examples.

(6) a. Çocuk ev-e koş-tu.
    child home-DAT run-PAST
    ‘The child ran home.’
   Not: ‘The children ran home.’

    Ali book-ACC read-PAST
    ‘Ali read the book.’
   Not: ‘Ali read the books.’

One might wonder whether it is still possible to keep the number neutral analysis and derive the singular interpretations via a competition story. In line with this idea, Bale et al. (2010) claim that Turkish bare plurals are exclusive of atoms in denoting pluralities only (see also Görgülü 2012). Namely, the bare plural kitaplar ‘books’ denotes the set $\{a \oplus b, b \oplus c, a \oplus c, a \oplus b \oplus c\}$ in their view. Maintaining this analysis, one might argue that the competition between number neutral bare singulars and strict plurals results in the singular reading of bare singulars as in (6). However, bare plurals in Turkish are actually inclusive of atoms and their pluralities just as in English, i.e. $\{a, b, c, a \oplus b, a \oplus c, b \oplus c, a \oplus b \oplus c\}$, as I will show below.\(^3\)

Krifka (2003), Sauerland et al. (2005), Spector (2007), and Zweig (2009) argue for a number neutral account of bare plurals in English. In these works, it has been observed that although bare plurals contain multiplicity as part of their denotation in positive contexts, they lose that requirement in downward entailing and question contexts. In other words, the ‘more than one’ meaning does not seem to be a strict requirement in their interpretation. It has been claimed that this is due to the number neutral denotation that they have, the multiplicity condition of which arises as a result of a conversational (scalar) implicature in positive contexts. So, a bare plural in English denotes a set of atomic individuals and pluralities.

This observation also holds for Turkish bare plurals as evidenced by the example in (7). If we had gone to the forest and come across one bear, it would be bizarre to respond to the question in (7) as ‘no’. Because seeing one bear is an efficient answer to the question in (7), the denotation of the bare plural ayılar cannot be ‘more than one’ bear.

(7) Orman-da ayı-lar-a rastla-dı-nız mı?
    forest-LOC bear-PL-DAT come.across-PAST-2PL Q
    ‘Did you come across bears in the forest?’

\(^3\)See Renans et al. (2017) for an experimental study showing the number neutrality of Turkish plurals.
yes, one CL see-PAST-1PL
‘Yes, we saw one.

b. #Hayır, bir tane gör-dü-k.
no, one CL see-PAST-1PL
‘No, we saw one.’

Now, consider (8b) where a bare plural appears in a negative context. In (8a), the scalar implicature surfaces since the ‘more than one’ interpretation is stronger than the ‘one or more’ interpretation. On the other hand, (8b) is felicitous when there are no children playing ball, but not if there is only one child playing, as would be predicted by a strictly plural account.

(8) a. Çocuk-lar sokak-ta top oynu-yor.
child-PL street-LOC ball play-PROG
‘Children are playing ball on the street.’

b. Çocuk-lar sokak-ta top oyna-mı-yor.
child-PL street-LOC ball play-NEG-PROG
‘Children aren’t playing ball on the street.’

The ‘one or more’ reading of bare plurals is also available in other downward entailing contexts such as the antecedents of the conditionals as in (9a) and the restrictors of universal quantifiers as in (9b). In both cases, the bare plural erkekler ‘men’ is interpreted neutrally.

(9) a. Eğer erkek-ler tarafından aldattı-dıysan, sen de biz-e katıl-abil-ir-sin.
if man-PL by were.cheated you also we-DAT join-ABIL-AOR-2SG
‘If you have been cheated by men, you can join us.’ (one or more men)

b. Erkek-ler tarafından aldattılan herkes biz-e katıl-abil-ir.
man-PL by was.cheated everybody we-DAT join-ABIL-AOR.
‘Everyone who has been cheated by men can join us.’ (one or more men)

Therefore, in light of the argumentation for English bare plurals, I argue that Turkish bare plurals are also number neutral and the multiplicity condition in positive contexts arises as a result of a conversational implicature.

Bale et al. (2010) use the following sentences in (10) as evidence for their strict plural account of Turkish bare plurals (pg. 8). The reasoning is as follows: If plurals were inclusive of atoms, then they would be expected to be predicated of singular subjects as well as plural ones. The example in (10b) shows that plurals in Turkish cannot be predicated of singular subjects.

(10) a. John ve Brad çocuk(-lar).
John and Brad child-PL
‘John and Brad are children.’

b. *John çocuk-lar.
John child-PL
Intended: ‘John is a child.’

However, -lAr in (10a) is not the genuine plural marker but the optional 3rd person plural agreement, which happens to be homophonous with the former. One way to distinguish the two is their stress pattern. The third person plural marker shifts the stress to the preceding syllable, whereas the genuine plural marker itself bears the stress (Göksel and Kerslake 2005). In (10a), the stress is on the syllable preceding -lAr, suggesting that it is the 3rd person plural agreement

---

4The bare plurals in (7), (8), and (9) can also be interpreted as definites. See Section 3.2.1 for details.
marker. Given that, the structure of (10a) can be roughly represented as the following:5

(11) \[
\begin{aligned}
[TP & \text{John ve Brad } \] \\
[V P & [NP \text{ çocuk }] \ COP] T+\text{-lar}
\end{aligned}
\]

We expect (10b) to be bad because the subject is not plural, so the 3rd person plural agreement is not realized on the predicate.

If (10a) is pronounced with the stress on -\text{lar}, then the sentence means ‘John and Brad are the children.’, not ‘John and Brad are children.’, receiving an equative interpretation. We still expect (10b) to be bad since the equative reading requires a maximal unique plural individual to be equated with \textit{the children}. The subject \textit{John}, however, is an atomic individual. So, there is a number mismatch between the two entities that are equated.6

To wrap up, we have seen that bare singulars denote sets of atoms and bare plurals are number neutral, inclusive of atoms and pluralities.

3.2. Singularity in kinds

In this section, I show that besides denoting atomic properties, bare singulars can also have singular kind reference following Dayal’s (2004) view on English definite singular kinds. This constitutes further evidence for their atomic property denotation. I will first discuss the properties of kinds by introducing plural kinds in Turkish and then return to singular kinds.

3.2.1. Overview of kind terms

We have seen that Turkish bare plurals are like English bare plurals in being number neutral. They are also equivalent in having the following primary readings: kind (12a), generic (12b), and existential (12c) (see Carlson 1977 and Chierchia 1998 for English bare plurals):

\textit{dinosaur-PL 66 million 38 thousand year ago extinct be-PAST}
‘Dinosaurs became extinct 66 million 38 thousand years ago.’

b. \textbf{Ayi-lar} genelde saldırgan ol-ur.
\textit{bear-PL usually aggressive be-AOR}
‘Bears are generally aggressive.’

c. \textbf{Kedi-ler} dışarda çiftleş-iyor.
\textit{cat-PL outside mate-PROG}
‘Cats are mating outside.’/ ‘The cats are mating outside.’

5Kornfilt (1996) and Kelepir (2003) claim that there is a null realization of the copula (\textit{COP}) -\textit{i} between the noun and the person agreement marker. The copula, being a clitic, shifts the stress to the preceding syllable.

6This is achieved by a competition with the singular definite denoted by the singular form due to Maximize Presupposition (\textit{MP}, Heim 1991). Recall that bare singulars are interpreted as singular in definite readings.
I suggest following Chierchia (1998) and Dayal (2004) that bare plurals start as type \(<s, <e, t>>\) and become kind terms of type \(<s, e, \cdot>\) via nominalization operation \((\text{nom})\), i.e. \(\lambda P_{<s, e, t>} \lambda s \lambda t x [P_t(x)]\). \((P_t\) is the extension of \(P\) at a situation \(s\).) This implies that bare plurals can directly combine with kind-level predicates. When they combine with object-level predicates, further operations come into the picture (Chierchia, 1998). One is the inverse of \((\text{nom})\), predicativization \((\text{pred})\), which takes the extension of the kind and returns the set of singular and plural entities that are the instantiations of the kind (in line with the neutrality of bare plurals), i.e. \(\cup: \lambda k_{<s, e, t>} \lambda x [x \leq k_s]\). \((k_s\) is the plural individual consisting of atomic members of the kind.) In generic contexts, the Generic operator quantifies over these instantiations. The other is Derived Kind Predication \((\text{DKP})\), which provides sort adjustment and introduces \(\exists\)-quantification over the instantiations of the kind provided by \((\text{pred})\) in a given situation in episodic contexts.

\[(13) \quad \text{DKP: If } P \text{ applies to objects and } k \text{ denotes a kind, then } P(k) = \exists x [\cup k(x) \land P(x)]\]

The application of DKP also results in narrow scope interpretation of bare plurals, as in English:

\[(14) \quad \text{a. Köpek-ler havla-m-yor.} \\
\quad \text{dog-PL bark-NEG-PROG} \\
\quad \text{‘Dogs aren’t barking.’} \\
\quad \text{b. } [\text{Köpekler havlamıyor}] = \neg \text{bark } (\cup \text{dogs}) = \text{DKP} \Rightarrow \neg \exists x [\cup \text{dogs}(x) \land \text{bark}(x)]\]

The fact that plural kinds are transparent to their instantiation sets is supported by the tests showing that access to the atomic level is necessary in object level readings (Schwarzschild, 1996). Below, among such tests the compatibility with reciprocals and the predicate come from different areas are applied.\(^7\) The compatibility of bare plurals with these tests shows that plural kinds have a see-through relation with their instantiations, since the atomic level of a kind term is accessible only if its instantiations are grammatically available. (15a) and (15b) exemplify generic and episodic contexts, respectively.

\[(15) \quad \text{a. Kedi-ler birbiri-ne saldır-ır.} \\
\quad \text{cat-PL each.other-DAT attack-AOR} \\
\quad \text{‘Cats attack each other.’} \\
\quad \text{b. Ayı-lar bu hayvanat bahçesi-ne farklı bölgeden gel-di.} \\
\quad \text{bear-PL this zoo-DAT different area-PL-ABL come-PAST} \\
\quad \text{‘Bears came to this zoo from different areas.’}\]

Differently from English ones, Turkish bare plurals can also have definite interpretations in object-level contexts besides narrow scope existential readings as is evident in the example (12c). This difference comes from the fact that Turkish lacks an overt definite article and we assume that the definite interpretations are achieved by covert type-shifting via iota. This makes bare plurals in Turkish ambiguous between narrow scope existential and definite readings.\(^8\)

\(^7\)Schwarzschild (1996) uses the incompatibility of collective/group-denoting nouns with reciprocals and the predicate live in different cities to show that collective nouns do not allow access to atoms.

\(^8\)Nom and iota can freely apply in Turkish because there are no overt versions that would block them. This is a consequence of the Blocking Principle proposed in Chierchia (1998) which is represented below.

(i) \quad \text{Blocking Principle: For any type shifting operation } \phi \text{ and for any } X: \neg \phi(X) \text{ if there is a Determiner D}
3.2.2. Singular kinds

What about bare singulars? Just like bare plurals, they can also combine with kind level and generic predicates as shown in (16a) and (16b). However, in episodic contexts, they are interpreted as strictly singular and definite as shown in (16c). This contrasts with bare plurals, which can receive narrow scope existential readings as in (12c).

(16) a. Dinazor 66 milyon 38 bin yıl önce yok ol-du.
   dinosaur-PL 66 million 38 thousand year ago extinct be-PAST
   ‘The dinosaur became extinct 66 million 38 thousand years ago.’

b. Ayı genelde saldırgan ol-ur.
   bear usually aggressive be-AOR
   ‘The bear is generally aggressive.’

c. Kedi dışarda çiftleş-iyor.
   cat outside mate-PROG
   ‘The cat is mating outside.’ Not: ‘(The) Cats are mating outside.’

The lack of existential readings with bare singulars is further shown by their inability to take scope under negation as illustrated in (17), where the only interpretation available is singularity and definiteness. This behavior of bare singulars would not be expected if they were kind terms the way plural kinds are, hence if their instantiations included atoms and pluralities. Namely, like plural kinds they would be derived by nom, and in episodic contexts they would get number neutral existential readings by DKP. Given their singularity and definiteness in episodic contexts, how bare singulars can have kind denotations seems to be mysterious considering the view that kinds are inherently plural entities (Chierchia, 1998).

(17) Kedi dışarda çiftleş-mi-iyor.
   cat outside mate-NEG-PROG
   ‘The cat isn’t mating outside.’

We can understand the behavior of bare singulars if we take them to be more like definite singular kinds in English (e.g. The lion is extinct.). Dayal claims that even though kinds (singular or plural) are conceptually plural, singular kinds are grammatically atomic. They are different from plural (and mass) kinds in not having a semantically transparent relation to their instantiations. Namely, they are impure atomic in the sense of Link (1983) and Landman (1989) behaving more like a collective noun. This means that pred or any similar operators like Carlson’s (1977) Realization (R) relation are undefined for singular kinds. The latter constitutes the relation between kinds and their instantiations, i.e. \( R(x, y) \) where \( y \) is a kind and \( x \) is an individual instantiated by that kind.\(^9\) Hence, DKP is also unavailable for them.

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\(^9\) By abstracting over \( x \), we would be able to get the instantiation set of a singular kind. This way they would not
Dayal’s claim is based on the idea that common nouns systematically denote properties of ordinary individuals and properties of (sub-)kinds. Just like other determiners such as every and a, when the definite determiner combines with the latter it yields taxonomic readings. Namely, the definite singular kinds are derived compositionally from the regular definite determiner and a common noun denoting a taxonomic property, i.e. \( tX [P(X)] \), \( X \) ranging over taxonomic entities. Based on that, lion in ‘The lion is extinct’ denotes a singleton set containing the unique lion kind, i.e. \( \{ \text{LION} \} \), if the domain of quantification is the set of taxonomic entities as LION, WHALE, etc. (excluding types of lions). The definite, the lion, denotes its singleton element.

Singular definite kinds in English are not compatible with object-level contexts (episodic as well as generic) unless the statement is applicable to the whole species (e.g. The rat reached Australia in 1770.). In other words, they are impure atomic terms whose only instantiation set (if available at all) includes a singular representative or prototypical object.

The same facts hold for singular kind terms in Turkish.\(^{10}\) Since Turkish lacks an overt definite marker, they are realized in bare form to which the covert \( \iota \) operator applies.\(^ {11}\) I also provide further evidence with respect to their impure atomicity by applying the tests for the accessibility of the atomic level. Consider (18) where the bare singular \( \text{ayı} \) is used in an episodic context and is incompatible with the distributive predicate come from different areas (cf. with (15b)).

(18)  \( \ast \text{Ayı} \text{ bu hayvanat bahçesi-ne farklı bölże-ler-den gel-di.} \)
      bear this zoo-DAT different area-PL-ABL come-PAST
      Intended: ‘Bears came to this zoo from different areas.’

The sentence in (18) shows that singular kinds do not allow distributive predication to entities we intuitively associate with them. Otherwise, they would be interpreted like plural kinds and yield grammatical results with these tests. Since singular kinds are impure atomic, the denotations of bare singulars in object-level contexts as in (16c) must be derived without reference to their kind denotations. More precisely, they denote atomic properties independent of being singular kinds. In cases like (16c), \( \iota \) combines with the atomic property denotation of bare singulars to yield singular definite interpretations.\(^ {12}\) However, as in English, if a singular kind in Turkish refers to the totality of species as a prototypical object, it is compatible with object-level predicates as in (19).

(19)  \( \text{Bilgisayar bu ülk-e-ye çok geç gel-di.} \)
      computer this country-DAT very late come-PAST
      ‘The computer reached this country very late.’

Similarly, in generic statements, singular kinds are acceptable again if they refer to the whole species as a prototypical object explaining their compatibility with genericity as in (16b). The fact that singular kinds block access to their instantiations also holds for generic contexts, as

---

\(^{10}\)I consider singular kinds in Turkish to be names of kinds, so they have the same denotation in every situation, like proper names. See Section 3.3.2.

\(^{11}\)This is also the case in languages like Russian and Hindi as shown in Dayal (2004).

\(^{12}\)Strong indefinite readings are not available for bare singulars due to Revised Meaning Preservation.
evidenced by their incompatibility with reciprocals (cf. with (15a)).

(20) *Kedi birbiri-ne saldı-ıır.
cat each.other-DAT attack-AOR
Intended: ‘Cats attack each other.’

To summarize, plurals are kinds and their object-level interpretations are derived via pred and DKP. On the other hand, bare singulars are ambiguous in being singular kinds and independently denoting atomic properties. In object-level contexts, their atomic property denotations are made use of unless a prototypical representation of the kind is meant. This is in line with the lack of narrow scope existential readings with them and their singular interpretations.

To wrap up the discussion so far, we have seen two types of evidence showing that bare singulars in Turkish denote sets of atoms. One was their singularity in argument positions and the other was their singular kind denotations.

3.3. Explaining neutrality

In this section, I will explain the apparent number neutrality of bare singulars in non-case marked direct object (21a) and predicate positions (21b), both of which stem from their singular kind denotations. The corresponding sentences in (5b) and (5a) are repeated below.

   Ali book read-PAST
   
   ‘Ali and Merve are children.’

3.3.1. Pseudo-incorporation

Öztürk (2005), following Massam (2001), claims that non-case marked bare singulars occupying a direct object position immediately preceding the verb undergo pseudo-noun incorporation (PI). The semantics of PI has been the focus of a number of accounts (e.g. van Geenhoven 1998, Farkas and De Swart 2003, and Dayal 2011, among others), all of which agree in that pseudo-incorporated (PI-ed) nouns are property denoting. Among them, Dayal (2011) claims that they simply modify the verb, the result of which denotes predicate of events-subtypes of the events.

Inspired by the analysis of the weak definites of English in Aguilar-Guevara and Zwarts (2010) (e.g. Lola is reading the newspaper.), I argue that Turkish PI-ed bare singulars take part in sub-event kinds in line with Dayal (2011), but as singular kind arguments instead of properties. Their number neutrality is an inference due to the conceptual plurality of singular kinds.

The claim that PI-ed bare singulars are arguments instead of modifiers comes from the fact that they block the occurrence of an extra object with the same thematic role as they bear. (This contrasts with Chamorro where theme-doubling is possible (Chung and Ladusaw, 2004).)
The semantics of Turkish numeral constructions

(22) *Ali Savaş ve Barış(-i) kitap oku-du.
Ali war and peace-ACC book read-PAST

The claim that PI-ed bare singulars are singular kinds instead of properties is supported by the following facts. First of all, they are interpreted neutrally although we have previously seen that their property denotation is atomic.\(^{13}\) Second, modification is incompatible with them, requiring indefinite or plural forms, unless it is meant to operate at the taxonomic domain, establishing sub-kinds.\(^{14}\) Consider the following contrast:

    Ali old book read-PAST
    ‘Ali read an old book/old books.’

    Ali technical book read-PAST

This contrast stems from the fact that singular kinds are built on taxonomic properties, not the ones of ordinary objects. (23a) is bad because the adjective old can be considered as operating at the level of ordinary objects with a meaning like worn-out or old in terms of its publication date, whereas the adjective technical in (23b) defines a sub-kind of the book kind, hence it is compatible with the PI-ed singular kind.\(^{15}\) Since singular kinds are impure atomic terms their instantiation sets are not available. Therefore, they cannot be type-shifted to sets of individuals suitable for modification by adjectives like eski ‘old’.

Finally, PI-ed bare singulars are non-referential at the ordinary object level as shown in (24a) (Öztürk 2005: pg. 27), but reference to the kind itself is possible as shown in (24b). (Both examples are meant to follow (21a).) This is expected since PI-ed bare singulars are kind terms, so they introduce discourse referents at the level of kinds, not ordinary objects. DKP is also not available for singular kinds. Otherwise, they would be referential at the ordinary object level via ∃-quantification introduced by it.

(24) a. #Reng-i kırmızı-y-dı.
    color-3POSS red-COP-PAST
    ‘Its color was red.’

b. Polisiye türü-y-du.
    crime kind-COP-PAST
    ‘It (the book kind) was crime.’

In summary, based on their syntactic argument status and the facts given above, I claim that PI-ed bare singulars are singular kind arguments.

I follow the view that there are event kinds as well as event tokens in the ontology as pursued in Schäfer (2007) and Gehrke and McNally (2011) (and references therein). I assume that event

\(^{13}\)Dayal (2011) argues that Hindi PI-ed bare singulars denote atomic properties, but number neutrality is achieved as a result of their interaction with atelicity. I have pursued this idea for Turkish previously as presented in the talk, but later realized that singularity is not necessitated in all telic contexts. For reasons of space, I will not discuss this issue.

\(^{14}\)Taxonomic modification is usually available with adjectives rather than more complex structures like relative clauses. It is because adjectives are considered to be providing natural classification as opposed to the others which are mostly restricted to temporal, stage-level modifications (Sadler and Arnold, 1994). However, depending on the context, relative clauses can also be taxonomic.

\(^{15}\)The sentence can be acceptable if oldness defines a sub-kind of the book kind with a meaning like ‘ancient/historical’ kind of books. In addition, for some speakers (23a) is good but only with a singular interpretation.
kinds are derived via \( nom \) (by a mereological treatment of events). \( Nom \) is considered to be a general operator also applying to events as a function from event properties to situations, from situations to the maximal event satisfying that property in that situation, i.e. \( \lambda P_{s,t,v} \lambda s \text{ te } [P(e)] \) (\( \text{iota} \) yielding the largest plurality of events here). Similarly, \( pred \) applies to event kinds and returns sets of event tokens in a given situation, i.e. \( \lambda k_{s,t,v} \lambda e [e \leq k] \).

For example, the reading event kind is given in (25a) which is derived by the application of \( nom \) to the reading event property \( \lambda s \lambda e [\text{READ}_s(e)] \), and the reading event token is given in (25b) which is derived by the application of \( pred \) to the reading event kind.

\[
\begin{align*}
(25) & \quad \text{a. } [\text{read}^{\text{kind}}] = \bigcap \lambda s \lambda e [\text{READ}_s(e)] = \lambda s \text{ te } [\text{READ}_s(e)] \\
& \quad \text{b. } [\text{read}^{\text{token}}] = \bigcup \lambda s \text{ te } [\text{READ}_s(e)] = \lambda e' [e' \leq \text{te } [\text{READ}_s(e)]]
\end{align*}
\]

\( Nom \) can also apply to an event property of \( s,v,t,> \) type that has a singular kind as its theme, e.g. \( \lambda s \lambda e [\text{READ}_s(e) \land T_h_s(e) = tX [\text{BOOK}(X)]] \), and the result of this application will denote a sub-event kind as shown in (26).

\[
\begin{align*}
(26) & \quad [\text{book-read}^{\text{kind}}] = \bigcap \lambda s \lambda e [\text{READ}_s(e) \land T_h_s(e) = tX [\text{BOOK}(X)]] \\
& \quad = \lambda s \text{ te } [\text{READ}_s(e) \land T_h_s(e) = tX [\text{BOOK}(X)]]
\end{align*}
\]

I argue that this sub-event kind forming process is PI. The singular kind \( book \) does not refer to any actual books, and its role is to restrict the denotation of the reading event kind by participating in it as a theme argument. This participation in return will yield a book-reading event kind, which is a sub-kind of the reading event kind. In other words, PI is a process where the taxonomy of event kinds is determined by thematic arguments.

Consecutively, the book-reading event kind will undergo \( pred \), which results in a set of event tokens, as shown in (27a). Then, this set of event tokens will take an agent argument and be existentially closed as shown in (27b) (ignoring tense).

\[
\begin{align*}
(27) & \quad \text{a. } [\text{book-read}^{\text{token}}] = \bigcup \lambda s \text{ te } [\text{READ}_s(e) \land T_h_s(e) = tX [\text{BOOK}(X)]] \\
& \quad = \lambda e' [e' \leq \text{te } [\text{READ}_s(e) \land T_h_s(e) = tX [\text{BOOK}(X)]]] \\
& \quad \text{b. } [\text{Ali book-read}^{\text{token}}] = \exists e' [e' \leq \text{te } [\text{READ}_s(e) \land T_h_s(e) = tX [\text{BOOK}(X)]]] \\
& \quad \land Ag(e') = \text{Ali}
\end{align*}
\]

Here, Ali is involved in an instance of the book-reading event kind. The assertion that at least one episodic event token of this event kind exists will correspond to the inference of reading one or more books which are the instantiations that the singular kind is conceptually associated with. This explains the number neutral interpretation of PI-ed bare singulars.\(^{17}\)

As a final remark, \( nom \) will be undefined for event properties with non-kind arguments. For

\(^{16}\)Mithun (1984) shows that kind-referring nouns are normally incorporated in languages that make use of incorporation. Following Mithun, Krifka et al. (1995) argue that incorporated nouns refer to kinds, and noun incorporation is a syntactic device to stay in the kind-oriented mode.

\(^{17}\)Additionally, subject PI is also available as shown by Öztürk (2005), e.g. \( \text{Ali-yi arı soku} \) ‘Ali got bee-stung’. I will not go into the details here but I argue that they also fall into the same analysis proposed for object PI.
example, it will be hard to impute to a reading this book event a sufficiently regular behavior so that it can qualify as an event kind (see Chierchia 1998). Instead, such arguments are introduced within event tokens, and they do not participate in (sub-)event kind formation.\textsuperscript{18}

In summary, the aim of this section has been to show that bare singulars occurring as non-case marked objects are singular kinds that participate in sub-event kind formation. Their number neutral interpretation is an inference due to the conceptual plurality of singular kinds.

3.3.2. The predicate position

Finally, I will discuss the number neutrality of bare singulars appearing in the predicate position. Analogous to the analysis of pseudo-incorporation, I claim that bare singulars in the predicate position can be singular kinds, and the apparent neutrality follows from that.

To recall, bare singulars can be predicated of plural subjects besides singular ones as exemplified in (21b), which seems to suggest that they denote number neutral sets. However, closer investigation reveals that this is not the case. Namely, when bare singulars in the predicate position are modified they are only compatible with singular subjects as shown in (28). Interestingly, though, if the adjectival modifier establishes a sub-kind/type of the noun that it modifies then the predication is also compatible with plural subjects as shown in (29).

\begin{align*}
(28) \quad & a. \quad \text{Ali yüksekli doktor.} \\
& \quad \text{Ali handsome doctor} \\
& \quad \text{‘Ali is a handsome doctor.’} \\
& b. \quad \text{*Ali ve Mehmet yüksekli doktor.} \\
& \quad \text{Ali and Mehmet handsome doctor}
\end{align*}

\begin{align*}
(29) \quad & a. \quad \text{Ali pratisyen doktor.} \\
& \quad \text{Ali practitioner doctor} \\
& \quad \text{‘Ali is a practitioner doctor.’} \\
& b. \quad \text{Ali ve Mehmet pratisyen doktor.} \\
& \quad \text{Ali and Mehmet practitioner doctor}
\end{align*}

The former case can be explained by the claim that bare singulars denote atomic properties, and they can be modified at the ordinary object level. Additionally, since they are atomic properties, they can only be predicated of singular subjects.

On the other hand, the latter case reminds us of the modification facts of PI. In parallel with this, the contrast given above can be attributed to the view that bare singulars can also appear as singular kinds in the predicate position, being only compatible with taxonomic modification.\textsuperscript{19}

However, how can singular kinds occur in the predicate position in the first place? We have previously discussed their impure atomicity which suggests that any type-shifting operation that would take a singular kind and return its instantiation set is not available. Therefore, predication is impossible in this way.

\textsuperscript{18}Öztürk (2005) claims that case assignment is not achieved by verbs but higher functional heads. Unlike canonical arguments introduced by the latter, PI-ed bare singulars do not receive case since they are complements to verbs.

\textsuperscript{19}Bare singulars in the predicate position can also be found in Romance and Germanic languages like Dutch, French, Spanish, and German, although their usage is more restricted compared to the ones in Turkish. See de Swart et al. (2007) for an account of them which is in similar lines with the analysis given here.
Instead, I propose that the usage of singular kinds in the predicate position is a process of naming the subject term with respect to a kind that it belongs to. This is achieved by the copula that plays the role of a null operator associating the two. The denotation that the copula has in such structures is given in (30a), and the logical form of the sentence Ali çocuk ‘Ali is child’ is represented in (30b). \( (k \text{ represents kinds, } K \text{ represents singular kinds, } R \text{ is Carlson’s Realization relation, and } NAME \text{ is a relation constituting the relation between kinds and their names.) Informally, (30b) can stated as the following: There is a kind that Ali is a member of, and that kind is named as } tX \text{ [CHILD}(X)] \text{ (the singular kind child).} \)

\[
\begin{align*}
\text{(30)} & \quad \text{a. } [\text{COP}] = \lambda x^K \lambda y \exists k \left[ R(y, k) \land NAME(k, x^K) \right] \\
& \quad \text{b. } [\text{Ali is child}] = \exists k \left[ R(\text{Ali}, k) \land NAME(k, tX \text{ [CHILD}(X)]) \right]
\end{align*}
\]

The motivation behind this claim is that singular kinds are names of kinds, as opposed to plural ones in Turkish. This is supported by the dediğin ‘that you call’ construction, with which you refer to the kind term by what you call it as exemplified below. It is only good with singular kinds, not with plural ones, suggesting that the kind-naming construction is only expected to be compatible with singular kinds.\(^20\)

\[
\text{(31) } \text{Bilgisayar(*-lar) dediğin } \text{Charles Babbage tarafından icat ed-il-di.}
\]

The kind-naming specification can also be achieved if the subject is a plural term considering that sum individuals can also be members of kinds. This explains the compatibility of bare singulars with plural subjects in the predicate position. The logical form of (21b) is given below, which can be informally stated as the following: There is a kind that the plural individual Ali \(+\) Merve is a member of, and that kind is named as \( tX \text{ [CHILD}(X)] \).

\[
\text{(32) } [\text{Ali and Merve are child}] = \exists k \left[ R(\text{Ali} \oplus \text{Merve}, k) \land \text{NAME}(k, tX \text{ [CHILD}(X)]) \right]
\]

To wrap up, bare singulars in the predicate position can be singular kinds and their compatibility with plural subjects comes from the null kind-naming specification.

4. Back to Counting: The Semantics of the Classifier tane

So far, we have seen that the property denotation of bare singulars in Turkish is atomic, which is in line with I&M’s view of numerals where they are argued to be modifiers of type \(<<e,t>,<e,t>>\) that combine with atomic properties.\(^21\) This way we can explain the grammaticality of constructions where a numeral is followed by a bare singular, instead of a bare plural (e.g. \( \text{iki kitap} \text{ ‘two book’}, \text{*iki kitap-
lar} \text{ ‘two book-PL’} \)).\(^22\) Let us now discuss the role of

\(^{20}\)This seems to be a language specific property, as the so called construction in English which can be considered similar to the dediğin construction is fine with both singular and plural kinds as observed by Carlson (1977).

\(^{21}\)In Turkish çok ‘many/a lot of’ and bir kaç ‘a few’ also combine with bare singulars rather than bare plurals. I suggest that they can also be considered to presuppose atomicity like numerals.

\(^{22}\)Some numeral constructions of Turkish can have plural marking on them, e.g. \( \text{Nice 20 yil-
lar-a!} \text{ ‘To multiple 20 years! (Cheers!)’}, \text{ and yedi cüce-
ler} \text{ ‘the seven dwarfs’}. \) In the former, the plural marker pluralizes the denotation.
the classifier *tane* in numeral constructions.

Classifiers are widely thought to be a means of mediating between the denotation of a noun and the numeral in obligatory classifier languages like Chinese. Krifka (1995) and Chierchia (1998) propose that classifiers are functions from kinds into sets of atoms constituted by the instantiations of the kind, i.e. \( \lambda x \lambda y \{ x(y) \rightarrow AT(y) \} \). Nouns in such languages uniformly denote kind terms of \(<s,e>\) type as they come out of the lexicon. Since kinds are inherently plural being equal to mass nouns in some sense, their atomic instances are not available for counting. Therefore, classifiers are required in order to reach the atomic level of the kind.

This view cannot be adopted for *tane*, though. Otherwise, it would be obligatorily attested with plural kinds, but plurals cannot occur in numeral constructions and *tane* is not compulsory. (Singular kinds would not be an option due to their impure atomic nature.) Instead, I propose that *tane* is a partial identity function which triggers a presupposition for atomic properties just like numerals.\(^{23}\) I also treat it as taking numerals (represented by \( f \)) as one of its arguments\(^{24}\).

\[(33) \quad [tane] = \lambda P_{<at>} \lambda f_{<at,at>} : \forall x [P(x) \rightarrow AT(x)] \cdot f(P) \]

This account immediately explains the grammaticality of constructions with the classifier which combine with a bare singular, but not a bare plural (e.g. *iki tane kitap* ‘two CL book’, \*iki tane kitap-lar ‘two CL book-PL’). The optionality of the classifier is a consequence of the fact that, besides numerals that can directly combine with atomic properties, the language has also a partial identity function that takes both numerals and atomic properties as its arguments.

As an optional element, the classifier seems to be redundant in the language. However, there are contexts in which it is obligatory. Contra English, ellipsis of the noun is impossible unless the numeral is accompanied by the classifier. This is also the case in partitive constructions.

\[(34) \quad \begin{array}{ll}
\text{a. } & \text{iki } *\text{(tane) elma verir mi-sin?} \\
\text{b. } & \text{Elma-lar-dan iki } *\text{(tane) elma} \\
& \text{two CL apple give Q-2SG} \\
& \text{two CL apple-PL-ABL} \\
\end{array} \]

‘Can you give me two (apples)?’

‘two of the apples’

Now let me discuss a possible hypothesis regarding the obligatoriness of the classifier in (34a) and (34b). I follow Lobeck (1995) (for (34a)) and Ionin et al. (2006) (for (34b)) in taking such structures to involve a null (deleted) noun which needs licensing by a head (proper head-government). I suggest that numerals in Turkish are in the specifier of the nominal projection as shown in (35) contra numerals in English which are claimed to take the NP as a complement in Lobeck (1995) and I&M as shown in (35c).\(^{25}\) Due to their non-head status, the former cannot

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\(^{23}\)Thanks to Veneeta Dayal for suggestions to explore this idea. Note that Bangla *-ra* is analyzed as a classifier that encodes a presupposition in Dayal (2014).

\(^{24}\)We do not have strong evidence with regards to the order of the combination.

\(^{25}\)In I&M, languages where numerals assign case to their nominal complements are argued to have the structure in (35c). Although English numerals do not pattern with this, they prefer to posit the same structure for them. The
license the elided NP. In the presence of the classifier the NP is extended by its projection as shown in (35b), so the elided noun is licensed by the classifier. \(^26\)

\[(35) \begin{align*}
\text{a.} & \quad \text{NP} \\
\text{b.} & \quad \text{CLP} \\
\text{c.} & \quad \text{NumP}
\end{align*} \]

\begin{align*}
\begin{array}{c}
\text{NumP} \\
\text{N'} \\
\text{N} \\
\text{NumP} \\
\text{CL'} \\
\text{CL} \\
\text{NP} \\
\text{Num} \\
\text{NP} \\
\text{N}
\end{array}
\end{align*}

The requirement for the classifier in ellipsis structures is also a property found in other optional classifier languages like Persian. This observation calls for further inquiry, but for now, it provides an interesting new dimension to our analysis of optionality in the Turkish classifier system. \(^27\)

In summary, the classifier in Turkish is a partial identity function that presupposes atomic properties, which, combined with I&M’s account of numerals, explains its optionality. The derivations of the numeral constructions are summarized below:

\[(36) \begin{align*}
\text{a.} & \quad [2 \text{ book}] = \lambda x \exists S [\prod (S)(x) \land |S| = 2 \land \forall s \in S \text{ book}(s)] \\
\text{b.} & \quad [2 \text{ tane book}] = \lambda x : \forall x [P(x) \rightarrow AT(x)]. \exists S [\prod (S)(x) \land |S| = 2 \land \forall s \in S \text{ book}(s)]
\end{align*} \]

5. Conclusion

In this paper, it has been argued that numerals in Turkish are modifiers of type \(<<e,t>,<e,t>>\), the lexical complement of which has to be atomic (Ionin and Matushansky 2006), contrasting with the account where they are treated as restrictive modifiers (Bale et al. 2010). It has been shown that bare singulars denote sets of atoms, and the classifier \textit{tane} is a partial identity function presupposing atomic properties.

This analysis establishes that the denotations of nouns in Turkish align with the denotations of nouns in English in that bare singulars are strict singulars and bare plurals are number neutral. However, the two languages differ in the absence/presence of number agreement in numeral constructions, which is interpreted as cross-linguistic variation.

As a concluding remark, in order to situate the findings for Turkish within a broader context and to appropriately draw out the implications for natural language generally, further research one suggested here for Turkish is not discussed in their paper, but it does not conflict with their semantic account of the numerals. In addition, because Turkish numerals do not assign case to nouns it is safe to assume a structure where numerals are in the spec of the nominal projections.

\(^26\) CL in (35b) is head-initial conflicting with the head-final property of Turkish. Instead, we can represent \textit{tane} in the Spec, CLP assuming a null, head-final CL head. The crucial point is that NP is a part of CLP in the presence of CL, but it is not inside NumP.

\(^27\) One can analyze the classifier as a semantically empty element having only a syntactic role. In such an analysis, the incompatibility of the classifier with plurals could be explained by the atomicity requirement of numerals. This approach is not adopted since they actually create a difference in meaning contributing an amount interpretation. The semantics of the classifier is still an ongoing project of mine and for present purposes, I want to preserve the role of the partial identity function for the classifier.
on relevant facts from other optional classifier languages like Western Armenian, Persian, and Hungarian is called for.

References


The pa/wa of imperative alternatives
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Abstract. This paper deals with topic markers interacting with discourse information in imperatives. It compares two topic markers from Slovenian (‘pa’) and Japanese (‘-wa’) and shows that while they mostly match in terms of the foci they associate with, their functions differ in imperatives: only ‘pa’ may yield a concessive imperative reading. It is shown that this reading can be derived while keeping a single entry for ‘pa’ by making attitudes of discourse participants part of the focus ‘pa’ associates with. The split between Slovenian and Japanese can then be attributed to minor differences in terms of which foci ‘pa’ and ‘-wa’ may associate with.

Keywords: imperatives, Slovenian, Japanese, alternative semantics, topic markers, focus, discourse particles, performative modality.

1. Introduction

Natural language semantics deals not only with what is said but also with what is not said. This is evident in work on information structure, where what must be accounted for is the relation between what is being said and what is already established due to context (Valduví, 2016). Similarly, the function of discourse particles is to relate to what is not being said. They usually do not contribute to the “core” propositional content of utterances. Rather, they convey information about the discourse participants (the speaker and the addressee of the utterance) (Zimmermann, 2011). Despite these similarities, the two domains are generally not explicitly connected in theoretical work. This paper takes a step in that direction with a case study of the function of topic particles from two languages—Slovenian and Japanese—specifically, their use in imperatives. As a baseline, topic particles in both Slovenian and Japanese are used to express contrast. In Slovenian, the particle is ‘pa’ and in Japanese ‘-wa’:

(1) a. Zvitorepec pa je plesal. [Slovenian]
   S.NOM pa AUX.3 danced.M
   ‘Slyboots was dancing (as opposed to doing something else).’

b. John-ga odori-wa-sita. [Japanese]
   John-NOM dance-wa-did
   ‘John danced (as opposed to doing something else).’

In both examples, in addition to the propositional content of the sentence (i.e. that Slyboots was dancing in (1a), and that John danced in (1b)), the particles relate the predicate ‘dance’ (or the event of dancing), which is a part of the utterance, to other predicates (or events) that are merely contextually given. Roughly put, ‘pa’ and ‘-wa’ convey that the relevant individual is dancing, and not doing something else they could conceivably be doing. That is what we mean when we say that ‘dance’ is contrasted. However, despite their similarity in (1), the two particles differ

1For comments and discussion we thank in particular Magda Kaufmann, Stefan Kaufmann, Jos Tellings, and the audiences at the UConn Meaning Group and Sinn und Bedeutung 22. The usual disclaimer applies.
when used in imperatives. Only ‘pa’ has what appears to be a discourse particle use. That is, only ‘pa’ can yield what we call a concessive imperative:

(2)  
   a. A: Don’t eat that fish! It’s poisonous.  
   b. B: I eat that kind of fish all the time, and I’m still alive.
   c. A (Slo.): Pa pojej jo!  
       [✓ concessive]
       eat.IMP.(2) 3.F.ACC
       ‘OK, eat it then!’
   c’. A (Jpn.): #Tabe-wa-si-ro-yo!  
       [✗ concessive]
       eat-wa-do-IMP-SFP
       ‘At least EAT it!’ (⇐ can only mean)

What distinguishes a concessive imperative from a canonical one is that the former signals a disagreement between the speaker and addressee along the lines of (3).

(3) A canonical imperative P! commits the speaker to wanting the addressee to make P true. A concessive imperative ⊢P! signals: (i) that the speaker wants the addressee to make ¬P true and (ii) that the speaker acknowledges the addressee wants to make P true.

In this paper, we argue that the concessive use of ‘pa’ can be captured without positing two homophonous versions of ‘pa’. Specifically, we claim that its “discourse particle” use is, in fact, identical to its function as a topic particle. We establish this by first closely comparing of the function of ‘-wa’ and ‘pa’ both outside imperatives (Section 2) and in imperatives (Section 3). We show that their behavior is parallel up to the point where we look at imperatives being contrasted with modals (Section 3.1) and more importantly concessive imperatives (Section 3.2), for which we establish that their core contribution in the discourse is to signal speaker-addressee disagreement to the point where this affects the speaker distancing ban characteristic of imperatives (Section 3.2.1). Based on this, we propose that concessive imperatives can be modeled in parallel with focus in an alternative semantics approach (Section 4); specifically, the disagreement conveyed by a concessive imperative is actually the result of a contrast between the attitudes of the speaker and addressee in the context. Finally, we discuss two analyses of what gives rise to the differences between ‘pa’ and ‘-wa’ in terms of licensing concessive imperatives.

2. Two languages, two particles, same foci?

The Japanese suffixal particle ‘-wa’ has two main interpretations: it can mark a thematic topic (aboutness topic) or a contrastive topic (see Kuno, 1973; Heycock, 2008). These functions are exemplified in (4a) and (4b) respectively (CAPS on the stressed syllable indicate focus).

(4)  
       [thematic topic]
       John-wa apple-ACC eat-PAST
       ‘As for John, he ate an apple.’

2We use the term concessive somewhat differently from its traditional use; see e.g. König (2009). We return to a more detailed discussion of what the concessive imperative reading exactly encodes in Section 3.2.
In (4a), ‘-wa’ attaches to the constituent that the sentence is about (i.e. John)—the thematic topic or theme of the sentence. However, what we focus on in this paper are cases like (4b), where ‘-wa’ marks a contrast between the constituent it attaches to (i.e. ‘apple’) and other constituents the speaker could have used in its place in the given context (e.g. a different fruit). Constituents to which this contrastive ‘-wa’ attaches get focal stress, so in (4b) ‘ringo’ is stressed.3 In general, contrastive ‘-wa’ can attach to a number of phrases of different categories: NPs (cf. (4b)), VPs (cf. (5a)),4 PPs (cf. (5b)), and APs (cf. (5c)). As indicated in the corresponding translations, the contrastive topic marker ‘-wa’ consistently marks contrast between the word or phrase it attaches to (its “host”) and other elements of the same category (or semantic type).

In Slovenian, similar constructions to those just discussed are expressed using the ‘pa’ particle.5 Like ‘-wa’, ‘pa’ can mark sentence topics by following them. This includes thematic topics, as in (6), as well as contrastive topics, as in (7). On other words, ‘pa’ in in (6) marks what the sentence is about (cf. ‘-wa’ in (4a)), and in (7) it signals contrast (cf. ‘-wa’ in (4b)); e.g. in (7a) ‘studied’ is contrasted with ‘eat’. Like with Japanese, we will focus on this later use.

3 ‘-wa’ itself can also be stressed; e.g. ringo-wa in (4b) can surface as ringo-WA. Furthermore, both ‘-wa’ and the constituent can get focal stress, as in RINGo-WA. See Tomioka (2010a) for relevant discussion.
4 The verb form in (5a) is called renyookei in traditional grammars and is sometimes seen as a nominalized verb. The exact category of the form is not relevant to the discussion here. See Tagawa (2008) for relevant discussion.
5 The particle has many other use beyond those that we discuss here (see Marušič et al. 2011, 2015 for discussion). Most notably, there is a conjunction ‘pa’. But it is probably a distinct element; it does not have the same form across different varieties of Slovenian, and differs from other instances of ‘pa’ in that it is not a 2nd position clitic.
b. Lakotniku je všeč meso, Trdonji pa (je všeč) solata.
H.DAT AUX.3 like meat.NOM T.DAT PA (AUX.3 like) salad.NOM
‘Hungerpot likes meat, whereas Thickhead likes salad.’

It should be noted that despite their semantic/pragmatic similarities (as thematic/contrastive topic) markers, ‘pa’ and ‘-wa’ differ in their morpho-syntactic distribution. Recall that ‘-wa’ is a suffix, but ‘pa’ is a 2nd position clitic. Note here that the 2nd position requirement applies to the whole clitic cluster (see Franks and King, 2000; Bošković, 2001), and ‘pa’ specifically can appear either before or after any other clitics in the cluster, as shown by the sentences in (8).6

(8) a. Lakotnik pa se ji je opravil.
H.NOM REFLEX ACC 3.F.DAT AUX.3 apologized.M
b. Lakotnik se ji je pa opravil.
H.NOM REFLEX ACC 3.F.DAT AUX.3 PA apologized.M
‘As for Hungerpot, he apologized to her.’

As reported by Marušič et al. (2011), ‘pa’ can even appear within the clitic cluster itself, but only if the following clitic(s) are focused, as illustrated in (9).7

(9) Lakotnik mu jo je vzel, Trdonja mu pa GA je vzel.
‘Hungerpot took her from him, whereas Thickhead took HIM/IT from him.’

This property of ‘pa’ is very telling with respect to its role as a topic marker. As shown further in (10a) and (10b), only elements below/to the right of ‘pa’ in a clause can bear focus.8

(10) a. Rekel sem, da Zvitorepca bom pa JAZ poklical.
said.M AUX.1 that S.ACC will.1 PA I call.M
‘I said that I (as opposed to someone else) will call Slyboots.’
b. Rekel sem, da Lakotnika bom pa (jaz) poKLIcal.
said.M AUX.1 that H.ACC will.1 PA I call.M
‘I said that I will call (as opposed to invite/hug/pat . . . ) Hungerpot.’

Crucially, in contrast to (10a) and (10b), nothing higher than/to the left of ‘pa’ can be focused. Thus, in (11a), the subject pronoun, which is higher than ‘pa’, cannot be focused. In the same way, the focus on the verb results in ungrammaticality in (11b).9

6Marušič et al. (2011) do not report any differences between the two sentences in (8), but (8a) is more natural with a contrastive topic interpretation, accompanied by stress on the relevant focused element to the right of ‘pa’.
7Slovenian clitic pronouns are exceptional in their ability to be stressed (Bošković, 2001).
8The ‘bot(m)’ and ‘pa’ clitic cluster is technically in the 3rd position here, as the topic ‘Slyboots’ appears right after the complementizer. Slovenian is more flexible with the 2nd position requirement than other languages in its family (Franks and King, 2000; Bošković, 2001; Sheppard and Golden, 2002), which we return to in Section 5.
9Both examples in (11) are grammatical if the word preceding ‘pa’ is not focused, just like the examples in (10) are (see footnote 8 regarding the exceptional 3rd position placement of the clitic cluster in such examples).
The pa/wa of imperative alternatives

    said.M AUX.1 that I WILL.1 PA call.M H.ACC
    int.: ‘I said that I (as opposed to someone else) will call Hungerpot.’

    said.M AUX.1 that call.M WILL.1 PA I H.ACC
    int.: ‘I said that I will call (as opposed to invite/hug/pat . . . ) Hungerpot.’

These examples show that ‘pa’ is indeed a topic marker—in that it must immediately follow the topic—foci can only appear to its right. Furthermore, the placement of ‘pa’ is restricted with respect to other focus sensitive particles like the clitic ‘že’ (“already”), which cannot precede ‘pa’, as seen in (12), showing that even elements that only associate with focus must follow ‘pa’.

(12) a. *Lakotnik se ji je že pa opravičil.
    H.NOM REFL.ACC 3.F.DAT AUX.3 already PA apologized.M
b. Lakotnik se ji je pa že opravičil.
    H.NOM REFL.ACC 3.F.DAT AUX.3 PA already apologized.M
    ‘As for Hungerpot, he already apologized to her.’

The placement of ‘pa’ is sensitive to information structure; topics (thematic or contrastive) always occur to its left, whereas foci and other focus sensitive particles may only occur to its right. Similarly, contrastive ‘-wa’ in Japanese marks the focus by attaching to it. In that sense, the information structure status of the constituents in a sentence can be “read off” the two particles in their respective languages by looking at their placement.

3. Imperatives with ‘pa/wa’

The focus of our paper is the behavior of the two particles in imperatives, and at first glance ‘pa’ and ‘-wa’ have the same semantic contribution in imperatives as in the plain declaratives seen above. As seen in (13) and (14), the use of ‘pa’ and ‘-wa’ marks contrast on “salmon”.

(13) a. A: I’m at the store, and they don’t have tuna, eel, or mackerel.
    b. B: Kupi pa LOsos-a.
        buy.IMP.(2) PA salmon-ACC
        ‘Buy salmon then.’

(14) a. A: To open a sushi bar, we have to buy lots of different kinds of fish. But we don’t have enough money to do so.
    b. B: SAke-wa ka-e-yo!
        salmon-WA buy-IMP-SFP
        ‘Buy at least salmon!’

\[10\] Notice that the contexts in (13) and (14) are slightly adjusted for each language due to the “at least” reading that arises with ‘-wa’, which is also available outside of imperatives; see 4.2).
3.1. Contrasting imperatives with modals

The special status of imperatives becomes apparent when they are contrasted with a modalized declarative. In the Slovenian example (15a), a contrast is made between the imperative roughly equivalent to *You should go to school* (marked by *‘pa’) and *You need to go to school* (explicitly negated in the first clause). The imperative is being contrasted with a modal clause, just like modals can be contrasted with other modals, as in (15b), where *need* and *can* are contrasted.¹¹

(15) a. Ni ti treba it v šolo, vseeno pa POJdi!
   not 3.DAT need go-INF in school.ACC anyway PA go.IMP.(2)
   ‘You don’t have to go to school, but you should go anyway!’

b. Ni ti treba it v šolo, vseeno pa lahKO greš.
   not 3.DAT need go-INF in school.ACC anyway PA can go.2
   ‘You don’t have to go to school, but you can go anyway!’

Examples like (15a) cannot be replicated in Japanese, but this seems to be independent from any differences in the imperatives themselves. That is, the use of *‘-wa’* to contrast different modals like in (15b) is limited to begin with. There are cases where *‘-wa’* can attach to modal elements, like (16), but it is not entirely clear if their function is parallel to that of (15b).

   John-NOM school-to go-thing-NOM-can-wa-do-but school.regulation-on go-NEG-may
   ‘John can go to school, but he does not have to go (given the school regulations).’

It might be that this difference is because of the “at least” reading of *‘-wa’*, which we return to in Section 5. If the split between Japanese and Slovenian seen here is real, it already indicates that despite the functions of *‘-wa’* and *‘pa’* being largely parallel as topic markers (as we saw above, there are differences in terms of the kinds of foci they may associate with). This will be important as we move on to our discussion of the asymmetry with concessive imperatives.¹²

3.2. Concessive imperatives

Recall that in Slovenian, but crucially not in Japanese, a topic particle may yield a concessive reading of an imperative. This asymmetry is illustrated again in (17).¹³

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¹¹One may here wonder whether examples like (15a) contrast different speech acts. However, we will argue that another reading, namely the concessive reading, involves contrast at the speech act level.

¹²But see Tomioka (2010a) who argues that *‘-wa’* operates on speech acts. It should be noted that speech acts in Tomioka (2010a) differ from what we will treat as speech act alternatives in the text below.

¹³We do not claim that Japanese lacks concessive imperatives. What we show here is that concessive imperatives with a contrastive topic marker are impossible. In fact, Japanese employs an alternative strategy to form concessive imperatives, shown in (i), where the conditional marker *‘nara’* is employed to convey the speaker’s concession.
In order to better understand what exactly is encoded in a concessive imperative, we can compare it with a couple of other non-canonical imperative functions, which at first glance appear to be similar. These are so called acquiescence and indifference readings (see von Fintel and Iatridou, 2017). The hallmark of the former is that they signal that the speaker does not have a problem with the addressee carrying out the action described by the imperative (e.g. ‘Sure. Go ahead. Open the window!’), but they do not function as commands and do not seem to impose an obligation on the addressee. Similarly, an indifference imperative (as the name suggests) signals that the speaker has no opinion about whether the addressee should or should not act in accordance with the imperative (e.g. ‘Open the window! Don’t open the window! I don’t care.’).

The similarity between concessive imperatives and the two other readings just discussed is the lack of the speaker imposing an obligation on the addressee, but crucially concessive readings cannot just be reduced to either acquiescence or indifference readings—they give rise to an additional inference: that the speaker and addressee disagree over the imperative. This is best illustrated by the infelicity of the Slovenian examples in (18) and (19), where ‘pa’-imperatives are respectively forced into an acquiescence and indifference context.

(18) a. A: It’s getting warm. Can I open the window?                 [X acquiescence]
    b. B: Seveda. #Pa odpri ga!
        sure PA open.IMP.(2) 3.M.ACC
        int.: ‘Sure. Open it!’

(19) a. A: It’s getting warm. Should I open the window?        [X indifference]
    b. B: #Pa odpri ga ali ne odpri ga! Mene ne briga.
        PA open.IMP.(2) 3.M.ACC or NEG open.IMP.(2) 3.M.ACC me.ACC NEG care
        int.: ‘Open it or don’t open it! I don’t care.’

(18) only works if the speaker wants to convey reluctance about letting the addressee open the window, whereas (19) is infelicitous even out of the blue. We argue that this is because concessive imperatives do in fact convey the speaker’s preferences, albeit indirectly; concession

(i) Nara, ik-e!
    If go-IMP
    ‘Well, go then!’

Interestingly, in Slovenian, a ‘pa’-concessive imperative may be preceded by a conditional clause, as in (ii), but due to reasons of space we leave the exploration of a potential parallelism between the two for future work.

(ii) Če tako misliš, (potem) pa pojdi!
    if this think.2, then PA go.IMP.(2)
    ‘If you think that’s the case, then go!’
involves the speaker expressing the addressee’s preferences in contradistinction with their own preferences. Concession crucially does not express speaker indifference, nor does it express that the speaker has no problem with the addressee carrying out the action described in the imperative—disagreement is actually the key. And as we show next, the addressee’s preferences actually have a privileged status in concessive imperatives.

3.2.1. Speaker distancing in concessive imperatives

When a canonical imperative is uttered, the speaker cannot also explicitly state a preference for the negation of the propositional content of that imperative, as shown in (20a) for English (Kaufmann, 2012; Condoravdi and Lauer, 2012). Follow-ups that have this effect, like ‘... but I don’t want you to’, can be seen as cases of distancing by the speaker (Stegovec and Kaufmann, 2015). The observation carries over to Slovenian and Japanese, as seen in (20b) and (20c).

(20) a. #Buy salmon! But I don’t want you to buy it.
   b. #Kupi lososa! Ampak nočem, da ga kupiš!
      buy.IMP.(2) salmon.ACC but not.want.1 that 3.M.ACC buy.2
      ‘Buy salmon! But I don’t want you to buy it.’
   c. #Sake-o ka-e! Demo watasi-wa kimi-ni soo-site-hosiku-nai.
      salmon-ACC buy-IMP but I-TOP you-DAT so-do-want-NEG
      ‘Buy salmon! But I don’t want you to do so.’

Crucially, distancing by the speaker is constrained differently in concessive imperatives. In a ‘pa’-concessive, the speaker may felicitously express a preference for the negation of the propositional content of the imperative, as in (21a).\footnote{The degradation in (21a) is due to the follow up feeling redundant—it essentially conveys what the concessive imperative already conveys on its own. It should also be noted that the distancing facts are more intricate than we have space to discuss here; see Condoravdi and Lauer (2012); Kaufmann (2014) for discussion. The key point remains: although the speaker appears to concede to the addressee’s preferences in a concessive imperative, the speaker’s original preferences do not entirely disappear—which is what we try to capture with our analysis below.} Note that this is not possible when ‘-wa’ is used with an imperative in Japanese as in (21b), highlighting the asymmetry between the two.

(21) a. ?Pa kupi lososa! Ampak (jaz) nočem, da ga kupiš!
       PA buy.IMP.(2) salmon.ACC but I not.want.1 that 3.M.ACC buy.2
       ‘Well, buy salmon then! But I don’t want you to buy it.’
   b. #Sake-wa ka-e! Demo watasi-wa kimi-ni soo-site-hosiku-nai.
      salmon-WA buy-IMP but I-TOP you-DAT so-do-want-NEG
      ‘Buy at least salmon! But I don’t want you to do so.’
Therefore, while uttering a canonical imperative publicly commits the speaker to the imperative, uttering a concessive imperative makes the speaker publicly acknowledge that the imperative is in line with the addressee’s preferences. An analysis of concessive imperatives must therefore capture that: (i) given a canonical imperative \( P! \), where \( P \) is a proposition that resolves a decision problem (a set of propositions), a concessive imperative \( \Box P! \) commits the speaker to believing \( \neg P \) is the optimal solution, and (ii) the speaker of \( \Box P! \) simultaneously acknowledges that the addressee entertains \( P \) as the optimal solution. We propose that although the solutions to the decision problem in (i) and (ii) are in direct conflict, they can both be expressed by a single imperative—a concessive imperative—if we model speaker and addressee commitments/attitudes as focus alternatives. The intuition is that when ‘pa’ yields a concessive imperative in Slovenian, ‘pa’ is associating with a “focused” representation of speech act participant commitments the same way as it associates with focused predicates in examples like (1a). We proceed to outline our analysis in the following section, providing first the necessary assumptions regarding the semantics of focus alternatives and the semantics of imperatives.

4. Analysis: Hidden alternatives

We propose that all the readings that ‘pa’ and ‘-wa’ can yield in imperatives—including, crucially, the concessive one—arise from the particles associating with different elements in the narrow focus of the sentence. The contribution of ‘pa’ or ‘-wa’ to the meaning (and function) of a sentence depends on which element is the narrow focus. The main upshot of the analysis is that a single lexical entry can be given for ‘pa’, without having to posit a special status for ‘pa’ in its discourse related use. We adopt the core ideas of alternative semantics approaches to focus (Karttunen, 1976; Karttunen and Peters, 1979; Rooth, 1985, 1992; Büring, 1997), namely: focus invokes a set of alternative propositions, which constitutes the focus value of a sentence (\([S]^{f,c}\)). In (23a), where ‘salmon’ is the focus, the focus value of the sentence is a set of propositions of the form \( Slyboots bought x \), where the focus is replaced by a variable of the same type as the focused element.\(^{15}\) The variable can correspond to any element of the right type that is salient in the given context (\(c\)); we represent this semi-formally, for ease of exposition, as in (23b).

\begin{align*}
\text{(23)} & \quad \begin{align*}
\text{a. Slyboots bought SALmon.} & \quad \text{b. } [S]^{f,c} = Slyboots bought \left\{ \begin{array}{l}
\text{salmon} \\
\text{tuna} \\
\text{eel} \\
\text{mackerel} \\
\ldots
\end{array} \right. \\
\end{align*}
\end{align*}

\(^{15}\)Minimally, the variable must have the same semantic type, but it may be further (contextually) constrained; e.g. in (23a) we may want to constrain the variable to kinds of fish. We abstract away from this in our discussion.
This focus value of a sentence is in contradistinction to its ordinary value ([S]^{o,c}), which is the proposition that is actually overtly expressed by the sentence in question:

(24) a. Slyboots bought SALmon. b. [S]^{o,c} = Slyboots bought salmon

The shorthand we will be using for the meaning of sentences with focus is illustrated in (25a); text in bold marks what is present in both the ordinary value and the focus value of the sentence.

(25)

a. Slyboots bought SALmon. b. [S]^c = Slyboots bought {salmon, tuna, eel, mackerel, ...}

Having established the basics of how focus can be interpreted in plain declarative sentences, we can now move on to imperatives. We will be following Kaufmann’s (2012) approach to the semantics of imperatives, where their characteristic semantics is attributed to a modal operator—which is at its at-issue level a necessity modal, but equipped with presuppositions that ensure the imperative can only be used performatively. We use represent this modal with ‘IMP’ with its meaning given in (26); following standard assumptions we treat it as a quantifier over possible worlds whose meaning depends on conversational backgrounds—functions from worlds to sets of propositions (Kratzer, 1981, 1991, 2012). These are the modal base (f), which yields a (necessarily consistent) body of information, and the ordering source (g), which induces an ordering among the worlds that comply with f (and is possibly inconsistent). Given this, we semi-formally represent the meaning of imperatives as illustrated in (27).

(26) [IMP]^c = \lambda f . \lambda g . \lambda p . \lambda w . (\forall v \in O(w,f,g))[p(v)]

(O(w,f,g) is defined as the set of worlds conforming to f at w (i.e., in \bigcap f(w)) that are best according to g at w)

(27) [Buy salmon!]^c = IMP you buy salmon

The advantage of taking this approach to imperatives may not be that evident at first. This approach does allow us to treat some imperatives with ‘pa’ and ‘-wa’ as straightforwardly as their declarative counterparts. Since the two elements are focus sensitive particles, imperatives where they associate with a focused direct object as in (28) can both be analyzed as having the meaning in (29), where (29a) is a rough paraphrase and (29b) the semi-formal representation.

(28) a. Kupi pa LOSos-a. b. SAke-wa ka-e-yo!

(29) a. Buy SALmon! [not tuna, eel, mackerel, ...]
The move to treat IMP as a modal also pays off in that we can explain examples where imperatives are being contrasted with modal verbs like in the Slovenian example in (30).

(30) Ni ti treba it v šolo, vseeno pa POJdi!
not 3.DAT need go-INF in school.ACC anyway PA go.IMP.(2)
‘You don’t have to go to school, but you should go anyway!’

In the alternative semantics approach, the variable representing the focused element in the focus value of the sentence is type-restricted, the imperative being contrastively focused against a modal verb implies that the two are of the same relevant type.\(^\text{16}\) This follows immediately from a modal analysis of imperatives. Thus, the meaning of the second clause in (30) can be analyzed as in (31)—as the contrast is explicit in this case, the set of propositions in the focus value is contextually narrowed down to the two containing ‘need’ and IMP (cf. (31b)).

(31) a. \([\text{You don’t need to, but}] \text{ GO to school anyway!}\)

b. \(\{\text{IMP need}\} \text{ you go to school}\)

This brings us to the concessive reading. On an intuitive level, a concessive imperative expresses at least two things: (i) an imperative (\(\approx\) you should \(P\)) and (ii) a disagreement between the speaker and addressee concerning the optimal solution to a decision problem (\(\approx\) I think you should \(\neg P\) vs. You think you should \(P\); see below for a definition). In order to capture these two layers of meaning, we suggest that the two can be thought of as its ordinary value and its focus value respectively, and crucially the ordinary value is tied to addressee preferences and public commitments, as we saw with the asymmetries in speaker distancing above.

A decision problem, following Kaufmann (2012), is a contextually given set of propositions describing future courses of events that jointly exhaust the context set.\(^\text{17}\) The prejacent of IMP presents one solution to it, and is therefore one of the elements in the set. What is odd about concessions compared to most other imperatives is that the prejacent of the imperative does not match the speaker’s solution to the decision problem, and the speaker in fact appears to have a preference for the addressee not to act on it (as Kaufmann 2012: 160 admits, this is somewhat problematic for her account). We propose that the speaker/addressee disagreement can be modeled the same way as contrast in information structure terms. The general idea is that

\(^{16}\)As noted previously, contrast seems to be needed to make modal alternatives salient with imperatives. We do not have a ready explanation for this fact, so we leave this question open for further study.

\(^{17}\)Note that decision problems could also be modelled in terms of question sets (cf. Roberts, 1996).
concessive imperatives are special in that they primarily express what the speaker thinks are the addressee’s preferences—unlike a canonical imperative, which primarily expresses the speaker’s preferences. We suggest that this is why ‘pa’ appears in concessive imperatives in Slovenian; as a contrastive topic marker, ‘pa’ must range over focus alternatives that in this case include (along with the imperative) the equivalent of an embedding attitude verb (≈ ‘A thinks that’ vs. ‘B thinks that’). Pending our discussion of how and where this is encoded, this can be thought of along the lines of Ross’s (1970) Performative Hypothesis as a literal—albeit silent—attitude verb dominating the matrix clause, and we express it as such in our derivation in (32).18

(32) a. **Speaker:** Eat the fish then!

b. \{ **You think that**

   **I think that**

\} IMP you eat the fish

In (32b), the two “attitude alternatives” are both part of the focus value of the sentence, but only the addressee’s is part of the ordinary value. The speaker’s attitude is still present though, as part of the focus value—which is meant to capture that the speaker’s preferences do not completely disappear with concessives. The imperative component and the prejacent stay constant as ‘Eat the fish!’, as they are shared by the ordinary and focus values of the sentence. At first glance, this seems at odds with the idea that the two attitudes include two mutually exclusive solutions to the decision problem (P/¬P), however we argue that the two opposing propositions actually arise analogously to Neg Raising, that is: ‘I don’t think that P’ having the meaning of ‘I think that not P’. Consider P! as the imperative in (32), where the ordinary value of the entire construction is You think P!. Note that by virtue of the latter being the ordinary value, we can infer that ¬I think P! (i.e. of the two alternatives I think P! is the excluded one). From this, we can derive I think ¬P! following analyses of Neg Raising in terms of the excluded middle (Bartsch, 1973; Heim, 2000; Gajewski, 2005) and the notion of Opinionated Speaker: a speaker is opinionated about α if it holds that the speaker is certain that α ∨ the speaker is certain that ¬α (Soames, 1982; Sauerland, 2004; Fox, 2007). The derivation is given in (33).

(33) ¬I think P!

I think P! ∨ I think ¬P!

∴ I think ¬P!

For our purposes, we assume that Opinionated Speaker is a pragmatic presupposition, and as such survives negation. Therefore, because ¬I think P! and I think P! result in a contradiction, (32) also infers I think that ¬P!. The consequence of this is that (32) can indirectly signal the speaker’s disagreement, which we argued is a key component in concession. Thus, if the information about “speaker/addressee attitudes” is encoded at some level where ‘pa’ may be associated with it, we can derive the concessive reading of ‘pa’-imperatives in conjunction with two independently needed assumptions concerning Neg Raising and the Opinionated Speaker.

The question now remains as to where these “speaker/addressee attitudes” are encoded. Recall

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18It may seem odd, given that focus marking is often directly tied to prosody, to talk about covert elements being in the focus. But see e.g. Heim (1992) and Ippolito (2007) for an unrelated use of focus on covert elements.
that both ‘pa’ and ‘-wa’ are sensitive to syntax in terms of the way the associate with focus. The former must precede the focus it associates with and follow backgrounded material, whereas the latter attaches to the focused constituent. A fairly standard way to approach the syntactic sensitivity of such particles is to assume that the different kinds of narrow focus correspond to different segments of syntactic structure.\(^{19}\) We can then think of focus sensitive particles like ‘pa’ and ‘-wa’ (represented as \(F\)) as needing to syntactically scope over the narrow focus. The rough syntactic representation of a matrix imperative in (34) can then be divided into three parts corresponding to the three main readings we discussed: (i) readings matching those in regular declaratives (\(F_1\) level), (ii) modal contrast (\(F_2\) level), and finally (iii) concession—contrast at the level of the “performative projection”, where speaker/addressee attitudes are encoded (\(F_3\) level).

\[\text{(34)}\]

\[
\begin{array}{c}
\text{utterance} \\
\text{\(F_3\) level} \\
\text{\textit{I}/You think} \\
\text{\(F_2\) level} \\
\text{\textit{I}/MP} \\
\text{\(F_1\) level} \\
\text{\textit{TP/vP}} \\
\text{\(\quad\)}
\end{array}
\]

But is the performative projection actually present in the syntax? There is evidence from the behavior of concessive imperatives in Slovenian suggesting that it is. Slovenian allows imperatives to be embedded in indirect speech reports (Sheppard and Golden, 2002; Stegovec and Kaufmann, 2015), as in (35). Note that this example also contains ‘pa’, which is in second position in the embedded clause, preceding everything but the complementizer. Crucially, such imperatives can only get a non-concessive interpretation.\(^{20}\) This means that the embedded clause cannot be interpreted as conceding to the addressee neither from the perspective of the original speaker—“Slyboots”, nor from the perspective of the actual speaker in the given context.

\[\text{(35)}\]

\[
\text{Zvitorepec je rekel, da \textbf{pa} kupi lososa.}
\]

\[
\begin{array}{l}
\text{S.} \text{NOM} \quad \text{je} \quad \text{rekel, da} \quad \textbf{pa} \quad \text{kupi} \quad \text{lososa}. \\
\text{\textit{I}/You think} \quad \text{\textit{CP}} \\
\text{C} \quad \quad \quad \leftarrow \text{modal contrast} \\
\text{\textit{I}/MP} \quad \text{\textit{MoodP}} \\
\text{\(F_2\) level} \\
\text{\textit{I}/MP} \quad \leftarrow \text{focus within the prejacent} \\
\text{\(F_1\) level} \\
\text{\(\quad\)}
\end{array}
\]

The lack of the concessive reading in embedded imperatives can be straightforwardly derived assuming that the performative projection is present only in matrix clauses, as in embedded

\(^{19}\)See e.g. Katzir (2007) for a specific implementation in terms of \textit{structural focus alternatives}.

\(^{20}\)Apart from focus on ‘\textit{salmon}’ (in the translation), other non-concessive readings are also available.
imperatives like the one in (35) the matrix attitude verb serves the same purpose (see Stegovec and Kaufmann, 2015; Stegovec, 2016). Note that ‘pa’ can only precede the imperative verb and its arguments as it must immediately follow the complementizer—and therefore the matrix clause. Since ‘pa’ can only associate with foci to its right and no performative projection is present in the embedded clause, our account correctly predicts the lack of a concessive reading.

What is the performative projection? Ross’s (1970) original performative hypothesis is riddled with problems (for discussion, see Speas and Tenny, 2003) and has largely been abandoned. However, there have been more recent revivals of similar ideas, such as Speas and Tenny’s (2003) Speech Act Participant projection, where the speaker and addressee are directly encoded into the syntax, or Pearson’s (2012) use of attitudinal operators, where the speaker or addressee are encoded as attitude holders via presuppositions. In both cases, these special syntactic means of encoding speaker or addressee attitudes are assumed to be absent in most embedded clauses, which fits our explanation for the lack of embedded concessive imperatives. In fact, Pearson’s approach is also adopted in Stegovec (2016, 2018) to account for independent asymmetries between matrix and embedded imperatives attested in Slovenian. There is thus converging evidence pointing towards the need to encode speaker and addressee attitudes in the syntax and our discussion of concessive imperatives confirms this further.

To conclude, we have shown that one can maintain a unified lexical entry for ‘pa’ in Slovenian and still explain both its regular function as a topic marker as well as its discourse particle function. In addition, this account also suggests that the characteristic semantic function of imperatives is the result of both a modal operator IMP (Kaufmann, 2012; Stegovec, 2016) and a syntactic encoding of the speakers attitudes—introduced by a silent performative projection in matrix clauses and the embedding attitude verb in embedded imperatives. This last split crucially allows for an analysis where the modal contrast reading is derived independently from the concessive imperative reading. It is not entirely clear alternative more “minimal” analyses of imperatives (e.g. in terms of To-Do Lists; Portner, 2007) would capture the same facts.

5. How are ‘pa’ and ‘wa’ different?

We have shown thus far how the different readings ‘pa’ and ‘-wa’ may yield can be derived. But recall that not all the readings ‘pa’ can yield are available with ‘-wa’. Most notably, ‘-wa’ does not give rise to concessive readings—unlike ‘pa’ in Slovenian. Although we do not offer a conclusive answer to this issue, we present two tentative solutions that will hopefully help to shed light on the language independent factors at play here. Assuming our analysis of concessive imperatives is on the right track, the concessive reading should be derivable in the same way in both languages—by invoking focus alternatives where speaker’s and addressee’s attitudes are contrasted. The two particles play a rather minimal role here, as they are only required to associate with the focus; they must scope over it. Based on this, then the lack of a concessive reading with Japanese ‘-wa’ should result from an independent point of variation between the two which prohibits it to scope over the performative projection.21

A promising split to examine is the fact that ‘-wa’—but crucially not ‘pa’—also has an “at least”

21A point of variation we do not consider is the ability of ‘-wa’ to yield hanging topics, which ‘pa’ cannot do:
reading associated with it (this can be seen as resulting from a scalar implicature triggered by ‘-wa’ or contrastive topics themselves; cf. Jackendoff 1972; Hara 2006; Tomioka 2010b). This effect is shown in relation to numerals bearing ‘-wa’ in (36).

(36) Taro-wa doitu-ni tooka(-kan)-wa taizaisimasi-ta.
    Taro-TOP Germany-in ten-day-for-WA stay-PAST
  ‘Taro stayed in Germany for at least ten days.’ (Schwarz and Shimoyama, 2011: 403)

This reading requires some notion of a scale or ordering between alternatives so that the focused expression can be “ranked” with respect to the other alternatives. It is not clear in contrast, how the focused speaker and addressee attitudes required for the concessive reading could be placed on a scale (at least if I think and You think exhaust all the options). Therefore, if the “at least” reading is an inherent property of ‘-wa’, when it associates with focus (cf. (2c’) vs. (1b,4b,5)), this could be sufficient to prevent it from scoping over the performative projection and therefore blocking it from occurring with concessive imperatives.

A more straightforward solution would be to tie the split directly to the morpho-syntactic status of ‘pa’ and ‘-wa’. Assuming that syntax maps directly to semantics (cf. (34)), restricting the syntactic positions the particles can occupy should also restrict their scope in semantics. Recall that ‘pa’ is a 2nd position clitic and ‘-wa’ (in imperatives) is a suffix placed above the verb stem and below the IMP morpheme (see (39b) below). Its morpho-syntactic distribution is even further restricted, as it can only attach to select “hosts” (e.g. it cannot attach to tense markers). ‘Pa’ also differs in a crucial way from other clitics in Slovenian with respect to clitic placement. For instance, Slovenian allows 2nd position clitics to occur in 1st position in some matrix clauses:

(37) a. Podal mu je svoj-o sablj-o.
    passed 3.M.DAT AUX.3 self’s-ACC sword-ACC
  ‘He passed him his sword.’
b. Mu je podal svoj-o sablj-o.
    3.M.DAT AUX.3 passed self’s-ACC sword-ACC
  ‘He passed him his sword.’

This exceptional placement is not possible in imperatives when the verb is the first non-clitic (cf. (38a,b)) (Sheppard and Golden, 2002). The only exception to this is ‘pa’, as shown in (38c).

(i) a. Kudamono-wa John-ga ringo-o tabe-ta
    fruit-WA John-NOM apple-ACC eat-PAST
  ‘As for the fruits, John ate an apple.’
b. *Hrana/o pa, Lakotnik ljubi klobase.
    food.NOM/ACC PA Hungerpot loves sausages.ACC
  ‘As for food, Hungerpot loves sausages.’

There is no reason to think the hanging topic construction is comparable to the sort of constructions we took for the basis of our analysis of concessive imperatives, where focus plays the main role.
This may be why ‘pa’ occurs with concessive imperatives—it can occur exceptionally high in matrix clauses, above all overt material (cf. (39a)). We suggest, then, that in matrix clauses this allows ‘pa’ to associate with focus in the performative projection. On the other hand, ‘-wa’ attaches to the verb (cf. (39b)), so it may scope over the verb and anything in its extended projection, but not anything outside it—thus excluding the performative projection.22

This approach may explain why there are some concessive imperatives in Japanese which can be analyzed as employing ‘-wa’. These cases have a sentence-initial host to which ‘-wa’ can attach (as opposed to the verb) and the concessive reading becomes available in this case, as shown in (40) (the phonological string ‘de-wa’ is often contracted into ‘zyaa’ in Japanese).

If in (40) the “high” ‘-wa’, like ‘pa’, occurs sufficiently high in the syntax to scope over the performative projection in the semantics, this would be expected from our analysis. But due to space limitations, we postpone a detailed analysis of such examples until future work.

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22Note that we are somewhat vague about how affixes take scope outside the word (and we are not alone in doing this). In simple terms, one can think of it analogously to how affixal negation works: if NEG is an affix on the verb, it does not only scope over the verb itself, but also the arguments the verb takes, etc. Crucially, it does not scope over elements outside the extended projection of the verb—such as what we assume the performative projection to be (and possibly MoodP). In this sense, ‘pa’ behaves like sentential negation, and ‘-wa’ like verbal negation.
6. Conclusion

In this paper, we hope to have shown the advantage of not treating information structure marking and discourse particles as separate entities at least with respect to concessive imperatives. We have shown, based on a careful comparison of Slovenian and Japanese, that the two domains do not have to be distinguished. The Slovenian topic particle ‘pa’, which also licenses concessive imperatives, does not have to be treated differently in terms of its contribution to the meaning of the sentence; both when it delineates the sentence topic from its focus and when it introduces a concessive imperative, it is merely associating with focus alternatives. The difference is only in the type of the elements that are in the sentence focus. Our discussion hopefully also contributes to the understanding of the fundamental semantic properties of imperatives. In particular, by looking at the meaning and function of concessive imperatives and exploring, more generally, which aspects of imperatives may be contrasted in the discourse. Of course, there are several questions that remain open. To what extent are similar strategies employed cross-linguistically? Can other discourse particles be modeled in the same way? These are important questions that warrant further study as we move forward with this project.

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The similarity approach strikes back: Negation in counterfactuals
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Abstract. The meaning of counterfactual conditionals is standardly described using the similarity approach (Stalnaker, 1968; Lewis, 1973). This approach has recently been challenged by Ciardelli et al. (2018). They argue that the similarity approach is in principle unable to account for the meaning of counterfactuals with an antecedent consisting of a conjunction embedded under a negation (\(\neg(p \land q)\)). Ciardelli et al. (2018) dismiss the approach on these grounds and offer an alternative. The main goal of the present paper is to defend the similarity approach against this attack. I will argue that the problem that underlies the observations in Ciardelli et al. 2018 is more general and not solved by the solution they offer. I will furthermore argue, against Ciardelli et al. (2018), that the cause of the problem is not the similarity approach, but the interaction of negation with the meaning of counterfactual conditionals. The paper will conclude with a first outline of a solution for the problem, which still uses the similarity approach, but combines it with an alternative semantics for negation.

Keywords: counterfactuals, negation, similarity approach, causality.

1. Introducing the main players and the storyline

How should we approach the semantics of counterfactual conditionals? If you look at the literature on this topic over the last 50 years, you will see that there is one particular approach that clearly dominates the field: the similarity approach of Stalnaker (1968) and Lewis (1973). We teach it to our students the first time they encounter the problem of counterfactual sentences and they grow up under the impression that this is the only way one should think about them. It became a paradigm, an empire in the vast field of the literature on counterfactuals. But paradigms come with a serious drawback: they can make us blind. We start to mistake theory for reality and, consequently, don’t question it anymore. That also seemed to happen in the case of the similarity approach. Even though at the beginning the approach was challenged from various angles, the criticism dried out as the approach became more and more established.

However, in a recent paper by Ciardelli et al. (2018) the similarity approach was called into question again. A team of Skywalkers stepped forward and challenged the empire. They put forward an argument that targets the very core of the approach and claim that this argument convincingly shows that we need to give up our paradigm, dismiss the similarity approach. In this paper we will take the side of the empire and pick up the glove that has been thrown at its feet. We will argue that even though the argument of Ciardelli et al. (2018) is extremely valuable, it does not succeed in eliminating the similarity approach. There is a way to account for the observations they make without giving up the paradigm.

We will start in Section 2 with a short introduction to the similarity approach and premise semantics for counterfactuals. In Section 3 we will have a look at the recent challenge brought

1I would like to thank Ivano Ciardelli, Luca Champollion and the audience at Sinn und Bedeutung 22 for feedback and discussion. Special thanks to Jonathan Pesetsky for proof-reading the manuscript.
forward by Ciardelli et al. (2018). We will discuss their evidence against the similarity approach and the alternative approach they propose. In Section 4 we will present our evidence against their proposal. We will argue that this evidence points actually to a more general problem concerning the interpretation of negation in conditionals. An alternative solution for the problem is sketched in Section 5. Section 6, contains conclusions and an outlook on future work.

2. The galactic empire

2.1. The similarity approach

From the perspective of possible worlds, the central question any approach to the meaning of counterfactual conditionals has to answer is the question of the selection function. A counterfactual is true if in a selected set of possible worlds that make the antecedent true, the consequent is true as well. But which situations should be selected? As Goodman (1955) has shown, it cannot be the set of all possible worlds that make the antecedent true. The conditional (1) seems intuitively to be true. But the consequent of the counterfactual doesn’t hold in all possibilities that make the antecedent true. What, for instance, if the match had been soaked in water overnight? This example shows that when we evaluate a counterfactual, we consider only a particular subset of the antecedent worlds. But how to select the right worlds?

(1) If I scratched this match, it would light.

The core idea of the similarity approach is that we select the possible worlds in which the antecedent is true and which in other respects differ minimally from the evaluation world \( w_0 \) of the counterfactual. This idea can be made precise using an order over possible worlds that, given the actual world, compares all other worlds with respect to their similarity to the actual world. This order is at least assumed to be a weak total order that centers around the actual world \( w_0 \) (the actual world is a smallest element of the order). A counterfactual with antecedent \( A \) and consequent \( C \) is now said to be true in case the consequent holds in all possible worlds that make the antecedent true and are minimal with respect to the order.\(^3\)

There exist various refinements of this theory, imposing all kinds of extra conditions on the order. The argument against the similarity approach that will be discussed in the next section targets the basic core of the theory, which is what we outlined here.

2.2. Premise semantics

We can also take an inferential perspective on the truth conditions of counterfactuals. Then we could say that a counterfactual is true in case we can infer the consequent from the antecedent. From the inferential perspective, the question of the selection function discussed above becomes the questions of the premise function. It is not possible to infer the consequent just from

\(^2\)This set can consist of one or more worlds, depending on the theory.

\(^3\)For the purpose of this paper we follow Stalnaker (1968) and adopt the Limit Assumption.
the antecedent. Certain facts of the evaluation world are used as additional premisses of this inference. To infer the consequent of (1) from its antecedent, we need to take into account the laws governing the behaviour of matches. We also assume (because this is true for the match in front of me) that the match wasn’t soaked in water overnight. In premise semantics this is spelled out in terms of the premise set $P$. $P$ is the set of true facts of the evaluation world that matter for the truth of a counterfactual. A counterfactual is said to be true in case the consequent can be inferred from the antecedent together with the laws and any maximal subset of the premise set consistent with the antecedent. Choosing maximal subsets consistent with the antecedent makes sure that we take as many premises into account as possible, without running into a contradiction. Let $\Pi$ be a set of sentences. We define $\text{Max}_\Pi(\phi)$ as the set of maximal subsets of $\Pi$ consistent with $\phi$. Then we can define the truth conditions of a counterfactual $A \rightsquigarrow C$ according to premise semantics as in A (Veltman, 1976; Kratzer, 1981b, a).

$$A \rightsquigarrow C \iff \forall S \in \text{Max}_P(A) : S \cup \{A\} \models C.$$ (A)

Suppose, for instance, the premise set $P$ consists of the sentences $p, q,$ and $r$ and we want to evaluate a counterfactual with the antecedent $\neg p$. The unique maximal subset of $P$ consistent with the antecedent would be the set $\{q, r\}$. A counterfactual with the antecedent $\neg p$ is true, in case the consequent follows from $\neg p$ together with $q$ and $r$ (and the relevant laws). It might happen that there are multiple equally maximal subsets of the premises that are consistent in the antecedent. In this case Clause A demands that the consequent has to follow from each of them together with the antecedent. Consider, for instance, a counterfactual with the antecedent $\neg p \lor \neg q$ using the same premise set. In this case there are two equally maximal subsets of $P$ that are consistent with the antecedent: $\{p, r\}$ and $\{q, r\}$. Rule A now demands that both of these sets together with the laws and the antecedent entail the consequent.

2.3. The relation between similarity approach and premise semantics

If you think about it, premise semantics is actually not that different from the similarity approach discussed before. The premises that together with the antecedent have to entail the consequent characterise the relevant antecedent worlds that we need to check for the truth of the consequent. Also in case of premise semantics, we want these selected worlds to be as close as possible to the actual world; we want to keep as many of the premises as possible. We can define an order on possible worlds that compares them with respect to the premises they make true: given the premises $P$ we say that a world $w_1$ is more similar to the actual world $w_0$ than a world $w_2$ in case the subset of $P$ true in $w_2$ is a subset of the subset of $P$ true in $w_1$. Based on this order the similarity approach will make the same predictions as Rule A.\footnote{For the formal details see Lewis 1981. If restrict ourselves to similarity relations that are strict partial orders, the equivalency also holds the other way around: given a similarity order, one can define a premise set $P$ such that Rule A counts the same counterfactuals true. We can, thus easily switch from one perspective to the other.} Going back to our example with the premise set $\{p, q, r\}$, this set would induce the order on possible worlds given in the left diagram of Figure 1 (for each world only those premises are given that are true in this world, false premises are left out). The worlds $w_3, w_5, w_6$ and $w_7$ all make the antecedent
If $\neg p$ had been the case true. Among these, $w_3$ is the world most similar to the actual world $w_0$ (dark orange in the second diagram of Figure 1). This is also the world where the maximal subset of the premises consistent with the antecedent is true. A conditional with antecedent $\neg p \lor \neg q$ is true in the worlds $w_2, w_3, w_4, w_5, w_6$ and $w_4$. The worlds most similar to the actual world are $w_2$ and $w_3$ (dark orange in the right diagram of Figure 1). They correspond to the two maximal subsets of the premises consistent with the antecedent that we calculated before.

This finishes our short presentation of the current paradigm for how to approach the meaning of conditional sentences. This is the empire in our story. Both perspectives, the similarity approach and premise semantics, will play a role in the discussion below. The attack of Ciardelli et al. (2018) is directed against the formulation using a similarity order, but for their alternative approach Ciardelli et al. (2018) build on premise semantics.

3. The empire under attack

3.1. Earlier strikes at the empire

We mentioned already at the beginning that the similarity approach has been attacked before. However, it is quite hard to really falsify the proposal. The reason is its generality. The argument has to work for any possible similarity order. It has to hit the very idea of approaching the meaning of counterfactuals using an order relation on possible worlds.

One way to truly hit the approach is by targeting its logic. The semantics of the similarity approach can be axiomatized (Lewis, 1973). The axioms capture the meaning of counterfactuals in terms of the inferences you are allowed to draw with them. One could attack the approach by arguing that the axioms the similarity approach give rise to are not the right ones: important properties of counterfactuals are not covered or some of the predicted inferences are in fact not valid for counterfactuals. An example for such an attack is the discussion concerning the law Simplification of Disjunctive Antecedents (SDA), see formula B. This law is not valid according to the logic of the similarity approach. In other words, SDA is not entailed by the axiomatisation. However, the principle seems to be intuitively valid, not only for counterfactuals (2a), but for conditionals in general (2b). Therefore, it has been argued, B should be a law of any adequate theory of the meaning of counterfactuals. The similarity approach doesn’t tick this box, hence, the argument continues, we need a different approach.
a. If Mary or Sue had been at the party, it would have been a lot more fun.

b. If it’s sunny tomorrow or aliens invade Amsterdam overnight, I will eat breakfast outside.

c. If Spain had fought with the Axis or the Allies, she would have fought with the Axis.

This line of attack is not without problems. Some authors have argued that, while (SDA) holds for the normal resolution of similarity, it is not generally valid. See, for instance, examples as in (2c): from this counterfactual one cannot infer that if Spain had fought with the Allies, it would have fought with the Axis. But this wouldn’t get the similarity approach completely off the hook; one would still need an account of the normal resolution of similarity. A different way to counter this attack is by replying that it only shows that the logic of the similarity approach needs to be strengthened. In other words, we need to put extra conditions on the similarity relation. However, there is an extra complication here. One can prove that no compositional account of the meaning of counterfactuals based on classical logic can validate (SDA) without validating Antecedent Strengthening (AS), given in formula C.

\[
(AS) \quad [\phi \sim \chi] \rightarrow [(\phi \land \psi) \sim \chi]
\]  

Now, we certainly don’t want (AS) to hold for the meaning of counterfactuals. This was the point of example (1): from If I scratched this match, it would light it doesn’t follow If the match was soaked in water overnight and I scratched it, it would light. On the one hand, this sounds like bad news for the similarity approach. It clearly shows that we cannot account for (SDA) by strengthening the logic. But you could also take this to be good news. The result shows that the validity of (SDA) is not a particular problem of the similarity approach. It is a problem of any approach to the meaning of counterfactuals that involves classical logic. This weakens the power of (SDA) as an argument against the similarity approach in particular. But if we want to adopt the similarity approach, we still need to explain why (SDA) seems intuitively valid.

So far we have been focusing exclusively on the conditional connective as an operator occurring in B. We implicitly assumed that it is the logic of this operator that needs to account for the critical observation. But there is another operator present in the relevant counterfactual: disjunction. Maybe the semantics assumed for the conditional connective is not the problem, but the semantics we assumed for disjunction. There are various other contexts in which the classical approach to disjunction is known to be problematic (Free Choice phenomena, exhaustive interpretation). This is also the angle from which Ciardelli et al. (2018) approach the problem of (SDA). To deal with the semantics of disjunction properly, they propose that we need to work with a more fine-grained semantic framework: inquisitive semantics (Ciardelli et al., 2018). Most importantly, in this framework, the meaning of a sentence is not equated with the

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5 At least not without giving up basic logical principles, like the substitution of logical equivalencies.

6 They are not the first to do so, see in particular Alonso-Ovalle 2009; Fine 2012; Schulz 2011 for related proposals.
set of worlds in which the sentence is true, but with a set of such sets, representing the maximal information states that would support the sentences. In most cases this set of sets just contains the set of worlds that make the sentence true. But the support condition for disjunctions introduce non-trivial alternatives: for each disjunct the set of worlds that make this disjunct true. The counterfactual operator $\sim$ is then proposed to quantify over the alternatives the antecedent gives raise to, see D below. For the definition of the connective $\rightarrow$ you can then pick your favourite notion of counterfactual entailment. It could be a similarity approach, the proposal of Ciardelli et al. (2018), or something else. Whatever you choose, the inference (SDA) will now be valid for $\sim$.

$$\phi \sim \psi \iff \forall p \in \text{Alt}(\phi) \exists q \in \text{Alt}(\psi) : p \rightarrow q$$

(D)

Thus, at least in the case of (SDA), what started out as a challenge for the similarity approach eventually led to the development of a more advanced semantics of other operators involved in the critical observation. The similarity approach itself remained relatively unaffected.

3.2. The recent challenge by Ciardelli et al. (2018)

We will now turn to the challenge posed by Ciardelli et al. (2018) for the similarity approach. They also target the logic of the similarity approach. But the critical inference that they address is not one that is invalid according to the similarity approach, but should be valid according to our intuition. In the case of Ciardelli et al. 2018 we are dealing with an inference that is valid according to the logic, but is intuitively invalid according to Ciardelli et al. (2018): the inference in E.

$$[\neg(\phi \sim \chi) \land \neg(\psi \sim \chi)] \rightarrow [\neg(\phi \land \psi) \sim \chi]$$

(E)

Ciardelli et al. (2018) empirically tested the intuitive validity of the inference. They conducted an online experiment in which they asked participants to judge the truth or falsity of the counterfactuals given in (3) in the scenario depicted in Figure 2. In this scenario a circuit connects two switches to a lamp. The wiring is such that the light is on if and only if the switches are in the same position. In the depicted scenario both switches, A and B, are up and the lamp is on.

(3)  a. If switch A was down, the light would be off.
    b. If switch B was down, the light would be off.
    c. If switch A or switch B was down, the light would be off.
    d. If switch A and switch B were not both up, the light would be off.

The results of their study are given in Table 1. The important observation is that even though the majority of the participants judged the conditionals (3a) and (3b) to be true, only 22% took

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7Ciardelli et al. (2018) propose as the support condition of a disjunction $s \models \phi \lor \psi$ iff $s \models \phi$ or $s \models \psi$. 

(3d) to be true as well. However, according to E, if (3a) and (3b) are considered to be true, then (3d) should be true as well. This is a serious problem for the similarity approach. The inference in E is valid for the logic of the similarity approach. That means it holds no matter what similarity relation you choose. Ciardelli et al. (2018) conclude from this that the approach is doomed to fail. The empire falls.

Let us take a closer look at what the problem seems to be. Using the terminology of premise semantics, if (3a) is true, this tells us that the fact that switch B is up is part of the premises of the evaluation world. For the counterfactual to be true, the position of the second switch needs to be kept constant. In the same way the truth of (3b) allows us to conclude that the fact that switch A is up is part of the premises. There might be also other facts that count as premises. We will just consider one other fact, \( q \). The premise set \{A, B, q\} results in the order over possible worlds described in Figure 3, first diagram. The sentence \( \neg(A \land B) \Rightarrow \neg Off \) is true in the worlds \( w_1, w_3, w_4, w_5, w_6, \) and \( w_7 \), the area shaded bright orange in Figure 3, second diagram. According to the similarity approach, the most similar worlds are \( w_1 \) and \( w_2 \) (dark orange in Figure 3, second diagram). In both of these worlds the light is off. Hence, the counterfactual in (3d) is predicted to be true – contra to the results of the empirical study.

The problem seems to be that interpreters of (3d) also consider a world like \( w_5 \) where both switches are down. In this world the light is on and, hence, the counterfactual is judged to be false. So, the set that should be selected as the set of relevant antecedent worlds should be the set \( \{w_1, w_3, w_5\} \), see the dark orange area in the last diagram of Figure 3. Thus, also worlds not optimal according to the order need to be selected as relevant antecedent worlds.

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\( q \) The reader might wonder why we do not consider the possibility that the state of the lamp is part of the premises. According to Ciardelli et al. (2018) (and many other authors) the reason is that this is a fact causally dependent on the antecedent. Such facts are deselected as possible premisses. But this issue and the way Ciardelli et al. (2018) account for it is completely orthogonal to the topic of this paper. We simply assume that this is taken care of.
Figure 3: The worlds selected by the similarity approach for the antecedent of Example (3d) (center) and the worlds that should be selected for this antecedent (right).

3.3. The alternative approach of Ciardelli et al. 2018: Cautious retraction

Based on the criticism discussed in the last subsection, Ciardelli et al. (2018) dismiss the similarity approach. They conclude that we need to select the relevant antecedent worlds in a different way. The alternative they propose is spelled out in terms of premise semantics. Recall the interpretation Rule A of standard premise semantics, repeated here as F. According to this rule a counterfactual is true in case all maximal subsets of the premises consistent with the antecedent together with the antecedent entail the consequent.

\[ A \rightarrow C \text{ iff } \forall S \in \text{Max}_P(A) : S \cup \{A\} \models C. \]  

(C)  

Ciardelli et al. (2018) propose to replace this rule with Rule G. According to this rule, a counterfactual is true in case the intersection of all maximal subsets of the premises that are consistent with the antecedent together with the antecedent entail the consequent. They choose to err on the side of caution and only allow fact to be kept constant in case they are part of all maximal subsets consistent with the antecedent. Thus, they predict a smaller subset of the premises to be carried over to the hypothetical scenario considered by the counterfactual, and, as a consequence, less counterfactuals to be true.

\[ A \rightarrow C \text{ iff } \bigcap \text{Max}_P(A) : S \cup \{A\} \models C. \]  

(G)  

With this interpretation rule they can account for observations concerning the critical example (3d). If we assume that the position of the switches, A and B, are part of the premises (together with other facts q), then there are two maximal subsets of the premises consistent with the antecedent \( \neg(A \land B) \): the sets \{A, q\} and \{B, q\}. The intersection only contains q; the positions of both switches in the actual world needs to be given up, because together they contradict the antecedent. We get the correct prediction that the consequent has to be true not only in the worlds \( w_1 \) and \( w_3 \), but also in \( w_5 \). The light isn’t off in all of these worlds (not in \( w_5 \)). Hence, the counterfactual comes out as false, as intended. For the counterfactuals (3a) and (3b)

\(^9\text{In fact, they propose that this set sets an upper limit for the premises kept. We will come back to this later.}\)
Ciardelli et al. (2018) make exactly the same predictions as the similarity approach. In these cases there is only one maximal subset of premises that is consistent with the antecedent.

Because the interpretation rule given in G only takes into account the truth-conditions of the antecedent, it predicts identical truth-conditions for counterfactuals with logically equivalent antecedents. Therefore, one might think that this proposal makes wrong predictions for (3c), which has an antecedent that is logically equivalent to the antecedent of (3d). The counterfactual (3c) we do want to come out as true. However, Rule G is combined with Rule D, assuming inquisitive semantics for the treatment of disjunction. From the perspective of inquisitive semantics, while the antecedents of (3c) and (3d) are truth-conditional equivalent, they are not semantically equivalent. Because Rule D is sensible to this semantic difference, we get different truth conditions for the counterfactuals. The counterfactual in (3c) is still predicted to be true. The rule D checks whether each disjunct of the antecedent counterfactually entails the consequent. Whether we define counterfactual entailment using Rule F or Rule G, we obtain that the truth of the consequent is in \( w_1 \) and \( w_3 \). In these worlds the consequent is true. Hence, the counterfactual is predicted to be true.

4. The empire strikes back–part 1

The empirical results of Ciardelli et al. (2018) seem to be rather devastating for the similarity approach. No matter how the similarity order is defined, there is no way the approach will predict that (3a) and (3b) are true, while (3d) is false. Does this mean that we have to dismiss the approach; give up on the empire? In this section I will argue that this conclusion would be too hasty. First, I will make a more conceptual point and show that the proposal of Ciardelli et al. (2018) can still be seen as an order-based approach. The solution Ciardelli et al. (2018) propose is more a variation of than an alternative to the similarity approach. Secondly, I will claim that the empirical results of Ciardelli et al. (2018) hint at a more general semantic problem. While Ciardelli et al. (2018) are able to account for one particular realisation of this problem, they fail to account for other instantiations. Thus, their solution strategy – targeting the similarity approach – does not seem to work.

4.1. Cautious retraction as cautious similarity

As the authors admit, their proposal comes in spirit very close to premise semantics. But still it is not a standard premise semantics approach. Conceptually, Ciardelli et al. (2018) consider their approach different in that they do not incorporate what they call the minimal change requirement. The central idea is not to keep as many facts of the premises as the antecedent allows, but “... rather, whenever we are faced with a counterfactual assumption, we determine a background of facts which are not at stake, and we hold all these facts fixed.” (Ciardelli et al. 2018: 35). The only restriction on the background is that it has to be a subset of \( \bigcap Maxp(A) \)\(^{10}\).

This sounds as if they completely do away with the idea of optimisation in the meaning of counterfactuals. The context fixes some set of background facts, to those facts we add the

\(^{10}\)See also footnote 8.
antecedent and then we check whether the consequent follows. But that is not a very faithful picture of what is going on here. Looking at their formal apparatus we see two differences from standard premise semantics: (i) the background, the facts relevant for the meaning of a counterfactual, can be a subset of the filtered premisses, and (ii) the condition for how to filter or retract premises has changed. To the first difference a defender of standard premise semantics could reply that premise semantics captures this by making the premise function context dependent. Ciardelli et al. (2018) do not show that their way to incorporate context dependence gives better results. The second difference is more substantial. Ciardelli et al. (2018) could have proposed that the upper limit of the background is the filtered premise set of standard premise semantics: $\text{Max}_P(A)$. They opt for being more cautious and choose $\bigcap \text{Max}_P(A)$ instead. However, the resulting truth conditions for counterfactuals can still be understood as result of an order-based optimisation process. In other words, and contra to what they seem to say, optimisation still plays a role in the semantics of counterfactuals. We will argue for this by showing that, just as for standard premise semantics, the truth conditions they predict for counterfactuals can be produced by selecting optional worlds based on a similarity order. You only have to be a bit more generous in what you count as an optimal world.

Assume, again, that $P$ is our finite set of premises, the facts of the evaluation word that matter for the truth of a counterfactual. As before, we use $P$ to define a strict partial order on possible worlds: $w_1 \leq_P w_2$ iff $\{ \varphi \in P \mid w_2 \models \varphi \} \subseteq \{ \varphi \in P \mid w_1 \models \varphi \}$. Let $M_P^+(\varphi)$ be the $<_P$-maxima in the set of worlds that satisfy $\bigcap \text{Max}_P(\varphi) \cup \{ \varphi \}$. Because $P$ is finite, this set is non-empty. We use $M_P^+(\varphi)$ to define truth conditions for counterfactuals as in A.

$$A \rightarrow C \text{ iff } \forall w': [w' \models A \land \exists w \in M_P^+(A)(w' \leq_P w)] \rightarrow w' \models C. \quad (H)$$

It can now be shown that the conditions in G and H are equivalent. Thus, to check the truth of a counterfactual, we don’t just look at the most similar antecedent worlds, but at all worlds smaller or equal to a certain limit, described by $M_P^+(A)$. Ciardelli et al. (2018) don’t give up on similarity, they just relax a bit the order-based selection criterium.

\hspace{1cm}

Proof. The result follows from $\{ w \mid w \models A \land \exists w \in M_P^+(A)(w' \leq_P w) \} = \{ w \mid w \models \bigcap \text{Max}_P(A) \cup \{ A \} \}$. So, we prove this equation.

$\Rightarrow$ Assume $u \in \{ w \mid w \models A \land \exists w \in M_P^+(A)(w' \leq_P w) \}$. Thus, there exists a world $w \in M_P^+(A)$ such that $v \leq_P w$. Because of the definition of $M_P^+(A)$, it follows that $w \models \bigcap \text{Max}_P(\varphi) \cup \{ \varphi \}$. Because $v \leq_P w$, it follows $v \models \bigcap \text{Max}_P(\varphi)$. We also know that $v \models A$. Thus, $v \in \{ w \mid w \models \bigcap \text{Max}_P(\varphi) \cup \{ A \} \}$.

$\Leftarrow$ Assume $v \in \{ w \mid w \models \bigcap \text{Max}_P(\varphi) \cup \{ A \} \}$. From this it follows $v \models A$. Because $P$ is finite, it follows that there is a maximal $w$ with $v \leq_P w$ and $w \models \bigcap \text{Max}_P(\varphi) \cup \{ A \}$. Hence, $v \in \{ w \mid w \models A \land \exists w \in M_P^+(A)(w' \leq_P w) \}$.

\hspace{1cm}

\footnotesize{11}Ciardelli et al. (2018) choose for a framework where the premises function is fixed as the set of facts (Ciardelli et al. 2018: 25). Then, context dependence has to be build in at a different place and they choose they notion of background as the right place.

\footnotesize{12}We work with a finite set of premises, because this is also what Ciardelli et al. (2018) do. Additionally, they work with premise sets that consist only of atomic sentences. We don’t adopt this restriction here.
4.2. Cautious similarity under scrutiny

We now turn to potential limitations of the alternative proposal of Ciardelli et al. (2018). As noticed before, the interpretation rule that according to Ciardelli et al. (2018) should take over the place of the similarity approach only takes the truth conditions of its arguments into account. Consequently, the approach makes the same predictions for logically equivalent antecedents. It is not that clear that this prediction is actually correct. Take, for instance the antecedent $\neg A$: "Switch A is down". $\neg A$ is logically equivalent to stating that switch A is down and that it is not the case that both switches are up, $\neg A \land \neg (A \land B)$. We can now compare the truth values assigned to counterfactuals with these two logically equivalent antecedents, see (4a) and (4b).

In the scenario in Figure 2 the first counterfactual is dominantly judged to be true (see Table 1). But what about (4b)? Is this counterfactual also intuitively true in the described context? That seems at least questionable. Hence, there appears to be a difference in interpretation of (4a) and (4b). The redundant information $\neg (A \land B)$ cannot just be ignored, contra to what the similarity approach and also cautious similarity tell us.

(4) a. If switch A was down, the light would be off.
    b. If switch A and switch B were not both up and switch A were down, the light would be off.

One could counter that this is not a particular strong argument against the proposal. Assume that we were to empirically test (4a) and (4b) and observed a significant difference between the truth-judgements of both counterfactuals. It would still be hard to say what caused the difference. Maybe the observed difference is due to pragmatic reasons: the sentence (4b) is reinterpreted because of the redundancies in the antecedent. In other words, we could get rid of the problematic example by moving it to the pragmatic waste basket.

4.3. The limits of cautious similarity—an empirical study

Let’s try to make the argument stronger. We also saw that the proposal of Ciardelli et al. (2018) doesn’t deviate a lot from the similarity approach. Again, it operates using a set of selected facts of the actual world (premises) that need to be kept true in the selected antecedent worlds. The proposal also tries to keep as many of the premises as possible. The only difference is that Ciardelli et al. (2018) are a bit more cautious about when to keep a premise: only in case this premise is an element of each maximal subset of the premises consistent with the antecedent. So, basically, this is still an approach based on minimisation of differences from the actual world. But if the minimisation forces you to make a choice between two premises, the approach refuses to choose and gives up both. If no such choice needs to be made, the approach makes exactly the same predictions as the similarity approach/premise semantics.

Assume now, I add to my counterfactual antecedent a formula expressing information about the

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13 In case this is not clear already, this holds also for the similarity approach.
14 Just to compare, standard premise semantics/similarity approach demands that you check the consequent for both choices.
premises that is true in the evaluation world. As long as the premises occurring in this formula
do not contradict other parts of the antecedent, they will be in each maximal consistent set.
Hence, the approach will try to keep them true in the considered counterfactual scenario. Con-
sider, for instance, the counterfactuals in (5) in the scenario described in Figure 4. The wiring
is as in the previous scenario of Figure 2, but now the position of the switches is different and
we add as an additional fact of the evaluation world that there is no electricity at the moment.

(5) a. If the electricity was working, then then light would be on.
b. If the electricity was working and switch A was up, then the light would be on.
c. If the electricity was working and switch A and switch B were not both up, then
the light would (still) be off.

As before, we use $A$ and $B$ to shorten switch A is up and switch B is up respectively. Addition-
ally, we use $E$ to shorten the claim that the electricity is working. As before, we can use
examples like (5a) and (5b) to establish that $E$, $\neg A$ and $B$ should be among the premises for
the scenario presented in Figure 4. Given this premise set, what would Ciardelli et al. (2018)
predict for the truth conditions of (5c)? In the first diagram of Figure 5 the different possibili-
ties with respect to this premise set are described ($w_0$ is, again, the actual world). In the green
worlds the light is off. The antecedent of (5c) is true in the worlds $w_3$, $w_5$ and $w_7$. The unique
maximal subset of the premises consistent with the antecedent is $\{\neg A, B\}$. Because there is
only one maximal subset with the antecedent, the approach makes the same predictions as the
similarity approach: $w_3$ is selected as the world where the consequent needs to be true, marked
dark orange in the first diagram of Figure 5. In $w_3$ the light is off. Thus, the approach predicts
the counterfactual to be true.

However, this is not the interpretation that we observe. I conducted an experiment using an on-
line questionnaire, designed with Qualtrics and distributed using Prolifix. The study duplicated
the setting of the studies conducted in Ciardelli et al. 2018, only changing the example. Par-
ticipants were asked to judge the truth/falsity of the counterfactuals given in (5) using a slider
bar (see Figure 6). The slider bar allowed for five positions that were in the evaluation trans-
lated into the numbers 0 − 4. The questionnaire was filled in by 51 native speakers of English,
who received 1 Pound as payment. The results are given in Table 2.\textsuperscript{15} The first two examples
were interpreted in agreement with the predictions of Ciardelli et al. (2018) (and the similarity
approach). This also confirms the premise set used to calculate the predictions. However, the

\textsuperscript{15} Some of the responses can be questioned, because the participant either answered the fillers incorrectly or
finished the study within a few seconds. In row 4 of Table 2 the corrected results are given. They are nearly
identical to the unfiltered results.
The counterfactual (5c) is by the majority of the participants judged to be false. The reason seems to be that the fact that switch B is up and switch A is down in the evaluation world shouldn’t be kept constant in the hypothetical scenario introduced by the antecedent. These facts need to be given up. This would give you as the set of antecedent worlds \( \{w_3, w_5, w_7\} \), marked dark orange in the second diagram of Figure 5. Then the counterfactual (5c) would correctly be predicted to be false.\(^{16}\)

There are a couple of options for how Ciardelli et al. (2018) could defend their approach against the results presented here. One way would be to use the same move made in the last subsection and submit the observations to the pragmatic waste basket. In the end, also in this case the antecedent of the critical counterfactual (5c) contains information that is redundant. The only difference is that now the redundancy is context dependent, while before contextual information didn’t matter. This is an easy move to be made, but only convincing in case one can back it up with a solid pragmatic story. One would probably want to turn to Grice’s maxims of conversation: the speaker must have a reason to include redundant information; this reason is to signal to the speaker that \( A \), and \( B \) shouldn’t end up in the premise set, etc. However, making this argumentation explicit won’t be easy. There are many possible reasons the speaker might have to mention redundant information. One would still need to explain how the hearer knows

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\(^{16}\)The problem that we noticed here is a problem that approaches to the meaning of counterfactuals based on the similarity approach share. Any approach that allows for substitution of logical equivalents will have trouble accounting for the observations made here.
that excluding A and B from the premise set is the only viable option here. Furthermore, one
would have to explain how Gricean reasoning can interact with the operation of a semantic
operator (the conditional connective).

4.4. Intermediate conclusions

In this section we explored the limits of the proposal of Ciardelli et al. (2018). We discussed
at least one concrete example which the approach cannot immediately account for. We also
outlined a possible pragmatic escape route for the approach, but observed that this route needs
to be worked out. However, evaluating the proposal of Ciardelli et al. (2018) is not our goal.
The purpose of this paper is to defend the similarity approach against the attack of Ciardelli
et al. (2018). To some extend we did that in Subsection 4.1 when I argued that the alternative
Ciardelli et al. (2018) propose is still an order-based approach and not really giving up on
similarity. But also the results of the study conducted can be used to that purpose. They point
to a different possible explanation of the data of Ciardelli et al. (2018), in particular one that
leaves the similarity approach unaffected.

The antecedent of (5c) is very similar to that of the critical example (3d). Both antecedents
involve a complex negation ¬(A ∧ B). In both cases we observe that if we apply minimisation,
we lose too many possibilities. In both cases we want to keep – in a certain sense– all logical
possibilities that the negation allows. In the next section we want to explore an alternative
explanation of the observations made in this paper; one that takes the negation to be responsible
instead of the semantics proposed for the conditional. Though, we will not argue here that this
solution should be preferred to the proposal of Ciardelli et al. (2018), the fact that this is a
plausible alternative explanation of the data shows that we do not need to give up the similarity
approach and the empire is safe for now.

5. The empire strikes back–part 2

5.1. ... by blaming negation

In this section I will develop an alternative explanation for the critical data of Ciardelli et al.
(2018), one that at the same time can explain the observations made in Section 4. The structure
of this solution employs the same strategy that we saw in Section 3.1 in reaction to the obser-
vation that the law (SDA) (simplification of disjunctive antecedents) seems intuitively valid for
counterfactuals. There, we ended up blaming the disjunction in the antecedent for the validity
of the inference. Following Alonso-Ovalle (2009); Fine (2012); Schulz (2011); Ciardelli

<table>
<thead>
<tr>
<th>sentences</th>
<th>true</th>
<th>false</th>
<th>indet.</th>
</tr>
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<tbody>
<tr>
<td>E ⇝ On</td>
<td>8</td>
<td>42</td>
<td>1</td>
</tr>
<tr>
<td>(E ∧ A) ⇝ On</td>
<td>43</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>[E ∧ ¬(A ∧ B)] ⇝ On</td>
<td>14</td>
<td>27</td>
<td>8</td>
</tr>
<tr>
<td>[E ∧ ¬(A ∧ B)] ⇝ On</td>
<td>9</td>
<td>26</td>
<td>5</td>
</tr>
</tbody>
</table>

Table 2: Results of the empirical study.
et al. (2018) we proposed that the disjunction introduces alternatives for each of its disjuncts. The conditional is then said to quantify over these alternatives, see rule D, repeated here as I. The connective $\mapsto$ that the rule builds on can still be interpreted according to the similarity approach. From a more general point, we analysed the intuitive validity of (SDA) as evidence that we need a richer semantic framework than just basic truth conditions, in particular with respect to the semantic treatment of disjunction.

$$s \models \phi \mapsto \psi \iff \forall p \in \text{Alt}(\phi) \exists q \in \text{Alt}(\psi) : p \mapsto q$$

(I)

The same solution will be now proposed with respect to the observations of Ciardelli et al. (2018) and Section 4. Again, we take the examples to show that we need a richer semantic framework. In particular, we need to respect the alternatives that expressions might introduce. But in addition to the earlier proposal that disjunction introduces alternatives, we will argue here that this also applies to negation.

5.2. A counterproposal

At the core of the present proposal lies the idea that negation, just as disjunction, introduces alternatives. We already need the semantics of the connective $\mapsto$ to quantify over alternatives in order to account for disjunctive antecedents. The alternatives that negation gives raise to will be treated the same way. We will argue that this is sufficient to account for the critical observations.

We adopt the framework of inquisitive semantics that Ciardelli et al. (2018) work with. The only thing we need to change is the support condition for negation. The solution we propose is inspired by standard approaches to truthmakers of negations. A truth maker of a formula $\neg \phi$ is standardly taken to be a formula $\chi$ that contradicts the formula $\phi$ in question ($\chi \perp \phi$). We additionally restrict truth makers of negations to relevant sentences/propositions that contradict $\phi$. This means we need a notion of relevance here, a question that we want to see answered. As we are concerned with semantics here, we use a notion of relevance that is context independent and relies on the sentence itself. Assuming a propositional language we define $\mathcal{L}(\phi)$ as the set of atomic formula occurring in $\phi$. To be relevant according to $\phi$ is to know the truth value of all elements in $\mathcal{L}(\phi)$. In other words, the question capturing what is relevant according to a sentence $\phi$ is $Q(\phi)$, the partition introduced by $\mathcal{L}(\phi)$ (i.e. the set of sets of possible worlds that assign the same truth value to all elements in $\mathcal{L}(\phi)$). For example, if $\phi = A \land B$, then $\mathcal{L}(\phi) = \{A,B\}$ and $Q(\phi) = \{AB,\bar{A}B,\bar{A}\bar{B}\}$. Any formula using the same vocabulary gives rise to the same issue. We extend support to issues in the standard way: an information state $s$ supports an issue $I$ ($s \models I$) in case $s$ completely answers $I$, i.e. $\exists i \in I : s \subseteq i$. The new interpretation rule for negation is given in J. It states that a situation supports $\neg \phi$ in case it’s a complete answer to the issue raised by $\phi$ and contradicts $\phi$.

17We could as well have used truthmakers semantics.

18To simplify notation we write $\overline{A} \overline{B}$ to refer to the set of worlds where $A$ is true and $B$ is false.
Figure 7: The alternatives predicted for the antecedents of (6a) (left) and of (6b) (right).

\[
s \models \neg \phi \text{ iff } s \models Q(\phi) \text{ and } s \bot \phi. \tag{J}
\]

According to this rule, the semantic value of the sentences $\neg A \lor \neg B$ and $\neg (A \land B)$ differ: $\text{Alt}(\neg A \lor \neg B) = \{\bar{A}, \bar{B}\}$ (see the left diagram in Figure 7), but $\text{Alt}(\neg (A \land B)) = \{AB, A\bar{B}, \bar{A}\bar{B}\}$ (see. Crucially, the sentence $\neg (A \land B)$ contains an additional alternative, $\bar{A}\bar{B}$. When this sentence occurs as antecedent of a counterfactual, also this alternative needs to counterfactually entail the consequent.

Let us see how this accounts for our examples. First we take a look at the critical examples of Ciardelli et al. (2018). As discussed before, we assume the premises in this case to include the positions of the switches. This gives the order of worlds displayed in Figure 7. The antecedent of (3c), repeated here as (6a) is true in $w_1$, $w_2$, and $w_3$, marked bright orange in the left diagram of Figure 7. The antecedent is disjunctive: $\neg A \lor \neg B$, hence, the counterfactual is predicted to be true if each disjunct separately counterfactually entails the consequent. We employ the similarity approach to compute counterfactual entailment. So, we predict that the counterfactual is true if the consequent is true in world $w_1$ and $w_2$ (left diagram of Figure 8). In these two worlds the light is off. Hence, (3c) is correctly predicted to be true.

(6) a. If switch A or switch B was down, the light would be off.
   b. If switch A and switch B were not both up, the light would be off.
   c. If the electricity was working and switch A and switch B were not both up, then the light would (still) be off.

The negation in the antecedent of (3d), repeated here as (6b), introduces the alternative set given in the right diagram of Figure 7. For each of these alternatives we have to check whether they counterfactually entail the consequent. In this case, this is not true. The alternative set $\{w_3\}$ does not counterfactually entail that the light is off. Hence, the approach correctly predicts that the counterfactual in (6b) is false. Finally the example (6c) in the scenario described in Figure 4. In this case the order over possible worlds looks a bit different, because the facts change, see Figure 9. The alternatives the antecedent gives rise to are $\{w_3\}$, $\{w_5\}$ and $\{w_7\}$. If we now check for each of these alternatives whether it counterfactually entails the consequent, we see that this is not the case. There is one alternative, $\{w_5\}$, that makes the consequent false.
Hence, the counterfactual (6c) is predicted to be false, just as intended.

6. Conclusions: The empire is still alive and kicking!

This paper addressed a recent challenge put forward by Ciardelli et al. (2018) against the similarity approach of Stalnaker (1968) and Lewis (1973), the standard approach towards the meaning of counterfactual conditionals nowadays. We have argued that the evidence that Ciardelli et al. (2018) put forward against the similarity approach is not conclusive. Our argument proceeded in two steps. First, we have shown that in certain scenarios also the counter-proposal of Ciardelli et al. (2018) runs into trouble. While their approach can possibly be saved using a pragmatic story, we have sketched an alternative analysis that provides a unified solution for these and the original examples of Ciardelli et al. (2018). This alternative is still compatible with the similarity approach. Hence, the similarity approach is not defeated, yet. The empire is safe.

The solution proposed here builds on inquisitive semantics. We proposed that not only disjunction, but also negation introduces alternatives. The conditional quantifies over these alternatives and checks for each of them separately whether they counterfactually entail the consequent of the counterfactual. We are, then, free to choose our favourite approach to defining this notion of entailment. Nothing stops us from choosing a similarity approach here. As we discussed in the last section, at least for all examples discussed in this manuscript a similarity approach...
makes adequate predictions.

Proposing that negation introduces non-trivial alternatives is a big step to take. This step needs to be supported by more evidence, preferably coming from the same sources that motivate the inquisitive treatment of disjunction. The good news is that there is a lot of literature on disjunction that we can build on. But this is work that still needs to be done. Some preliminary independent evidence for the semantics for negation proposed here comes from the exhaustive interpretation of answers. Here it has been observed that negative answers cancel or restrict an exhaustive interpretation. Also exhaustive interpretation is standardly modelled as selecting models that are minimal with respect to some order. Another interesting fact is that many languages develop question markers out of their markers of negation.\(^{19}\) Something similar has been observed for disjunction as well.

Negation is a very exciting topic that hasn’t received sufficient attention, yet. But this seems to be changing. There are a number of interesting projects, also in the philosophical literature, that are concerned with the linguistic and logical properties of negations at the moment. This manuscript is just another example of this change.

References


\(^{19}\)Thanks to Andreas Haida for pointing this out to me.
Decomposing universal projection in questions

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Abstract. Revising a proposal by Guerzoni (2003), we propose to derive universal projection of presuppositions in wh-questions, where attested, from a family of three felicity conditions on question use. Assuming that these felicity conditions can be violated under certain conditions, this proposal predicts a typology of contexts where universal projection can exceptionally be unattested. We propose that this prediction is correct, presenting a family of scenarios where the expected absence of universal projection is observed.

Keywords: wh-questions, universal presupposition projection, felicity conditions, bridge principles.

1. Introduction

Presuppositions have been said to project universally from under wh-phrases in wh-questions (e.g., Schlenker 2008, 2009; Abrusán 2011, 2014; Nicolae 2015). We can state this generalization as in (1), where $\pi$ maps an expression to its presuppositional content, and R and S are the wh-phrase’s property denoting restrictor and scope, respectively.

(1) **universal projection generalization**

$\pi(\text{wh R S}) = \lambda w. \forall x [\llbracket R \rrbracket(x)(w) \rightarrow \pi(S)(x)(w)]$

For example, as stated in (3), R in (2) expresses the property of being one of those ten boys, and due to the factivity of *regret*, $\pi(S)$ is the property of having been invited by Bill. According to the generalization in (1), then, (2) presupposes that Bill invited each of those ten boys.

(2) Who [R among those ten boys] [S does Mary regret that Bill invited _ _]?

(3) a. $\llbracket R \rrbracket(x)(w) \Leftrightarrow x$ is one of those ten boys
b. $\pi(S)(x)(w) \Leftrightarrow$ Bill invited x in w

We will review two existing approaches to the presupposition projection behaviour of unembedded wh-questions: the *local context* approach, due to Schlenker (2008, 2009), and the *pragmatic bridge* approach, due to Guerzoni (2003). Under the local context approach, the same calculus drives projection from under wh-phrases that also drives projection from under universals and other quantificational phrases in declaratives. The pragmatic bridge approach, in contrast, divorces projection in wh-questions from projection from under quantificational phrases in declaratives, and instead credits presupposition projection in wh-questions to pragmatic con-
We will propose a development of Guerzoni’s (2003) pragmatic bridge approach by positing a family of three pragmatic bridge principles. We propose that this development is motivated by certain instances of non-universal projection in wh-questions, which do not seem to have been observed previously. We propose that non-projection in those cases can be understood in terms of the suspendability of the pragmatic principles that we posit.

2. Two approaches to presupposition projection in wh-questions

2.1. Local context account

Schlenker (2008, 2009) assumes that presuppositions project universally both from under quantificational determiner phrases and from under wh-phrases. For example, consider (4) on a reading where him is anaphoric to the matrix subject; under Schlenker’s assumption, this example, like (1) above, presupposes that Bill invited each of those ten boys.

(4) None [R of those ten boys] [S regrets that Bill invited him].

Schlenker proposes a calculus that indeed applies to (1) and (4) in the same way. Here we sketch Schlenker’s (2009) rendition of the proposal, which we dub the local context account. The account requires, in a nutshell, that a presupposition be entailed by its so-called local context. With S understood as above, the local context is the strongest property P such that restricting S with P is globally vacuous in the context set (in the sense of Stalnaker 1978), i.e., does not alter the interpretation of the structure as a whole relative to the context set. In cases like (1) and (4), the local context is as shown in (5), the conjunction of the context set c with the restrictor property, i.e., the property given by R.

\[
\lambda x. \lambda w. c(w) \land \lbrack R \rbrack(x(w)
\]

The fact that the local context of S in both (1) and (4) entails the restrictor property is due to the fact that both no and wh participate in an inferential pattern known as conservativity (Barwise and Cooper 1981; Keenan and Stavi 1986): both of the equivalences in (6) are supported by intuitions, as exemplified by the intuited equivalences stated in (7).

\[
\begin{align*}
\text{conservativity} \\
\text{a. } no R S & \equiv no R \land S \\
\text{b. } wh R S & \equiv wh R \land S
\end{align*}
\]

\footnote{We extrapolate slightly from Schlenker’s (2009) brief discussion of wh-questions, which does not explicate the role of conservativity in the wh-question case.}
(7)  a. No boy complained ≡ No boy is a boy who complained
    b. Which boy complained? ≡ Which boy is a boy who complained?

As detailed in Schlenker (2009), given conservativity, the requirement that the local context entail $\pi(S)$ in cases like (1) and (4) derives universal projection as a pragmatic condition (Stalnaker 1973). It does this in virtue of deriving (8), requiring that the universal presupposition be entailed by the context set.

(8)  universal projection derived
    $[\text{no } R \ S]/[\text{wh } R \ S]$ is felicitous in $c$ only if $c \subseteq \{w: \forall x[[R](x)(w) \rightarrow \pi(S)(x)(w)]\}$

As intended, this derives parallel universal projection from under quantificational determiners like no (Schlenker 2008, 2009; Chemla 2009), and for wh-questions (Schlenker 2008, 2009; Abrusán 2011, 2014; Nicolae 2015).

2.2. A pragmatic bridge approach

The second approach to presupposition projection in wh-questions exploits natural conditions on the felicitous use of (unembedded) questions. Guerzoni (2003: p. 50, 91) proposes a felicity condition worded as in (9).

(9)  question bridge principle
    A question is felicitous ONLY IF it can be felicitously answered (i.e. only in contexts where at least one answer is defined)

It will be useful to spell out this principle in some greater detail, under Guerzoni’s own assumptions about presuppositions and the semantics of questions, listed in (10).

(10)  a. Frege-Strawson view of presupposition
       $\pi(\phi) = \text{dom}(\llbracket \phi \rrbracket)$
    b. Stalnaker’s assertion bridge principle
       $\phi$ is felicitous in $c$ only if $c \subseteq \text{dom}(\llbracket \phi \rrbracket)$
    c. Hamblin-Karttunen semantics
       $[\text{wh } R \ S] = \lambda w.\{[\text{S}](x)|[R](x)(w)\}$

As stated in (10a), the proposed elaboration assumes, in the Frege-Strawson tradition, that the semantic presupposition carried by a sentence is encoded as a definedness condition: construing propositions as functions from possible worlds to truth values, the presupposition is given by the set of possible worlds that serves as that function’s domain; (10a) feeds the bridge principle for assertions in (10b), due to Stalnaker (1973): for an assertion to be felicitous, the domain of the relevant proposition must be entailed by the context set; (10c) states the familiar Hamblin-Karttunen semantics for wh-questions (Hamblin 1973; Karttunen 1977).
Given these assumptions, and pretending for ease of exposition that Stalnaker’s assertion bridge principle exhausts the felicity conditions on assertions, we can reconstruct Guerzoni’s question bridge principle as in (11), requiring that in some context set world, the question extension contain a Hamblin-Karttunen answer whose domain is entailed by the context set.

\[
\text{(11) question bridge principle} \\
\quad \text{Q is felicitous in c only if} \\
\quad \exists w.p [w \in c \land p \in Q(w) \land c \subseteq \text{dom}(p)]
\]

We will start evaluating Guerzoni’s account in the next subsection, in the context of a preliminary comparison of the two approaches.

2.3. Preliminary comparison of the approaches

We submit that both approaches reviewed above have considerable conceptual appeal. The local context approach is attractive in virtue of it providing a general and predictive account of presupposition projection. The assumptions about conservativity it relies on are independently established and hence do not incur any theoretical cost. The pragmatic bridge account, too, we take to enjoy independent conceptual motivation. The question bridge principle is surely a condition that is expected to be observed at least in prototypical uses of questions. After all, it seems plausible that a question that necessarily lacks any felicitous answer fails to serve a proper purpose in conversation and is therefore itself infelicitous. To this rationale, we add that the question bridge principle is a central (implicit or explicit) ingredient of existing analyses of certain island effects in wh-questions (Oshima 2007; Simonenko 2016; Schwarz and Simonenko 2016), which therefore provide potential independent motivation.

However, as developed so far, the two approaches are not on a par with regard to empirical predictions. The difference that is the most relevant in the present context, and perhaps also the most obvious, is that the Schlenker’s account derives universal projection in wh-questions while Guerzoni’s merely derives existential projection. For example, Guerzoni’s account merely predicts (2) to presuppose that Bill invited some of those ten boys, not that he invited each of them. As matters stand, then, to the extent that the universal projection generalization for wh-questions is correct, the local context account emerges as the more adequate of the two.

We will argue below that the universal projection generalization is in fact less robust than it has been made out to be. We will then formulate a version of the pragmatic bridge account in terms of a family of three felicity condition on questions that does derive universal projection. We further propose that the violability of those principles predicts a typology of non-universal projection cases that is indeed attested.

3. A first case of non-universal projection

While the universal projection generalization for wh-questions seems consistent with the relevant examples discussed in the literature, we take it to be clear that universal projection is
not always attested. Here we provide a first set of illustrations. The unembellished universal projection generalization predicts B’s question in (12) below to presuppose that every member is female.

(12) A: Some member nominated herself.
    B: Which [R member] ([S nominated herself])?

This is so, at least, if the feminine gender marking on the reflexive pronoun *herself* is analyzed as a presupposition trigger (Cooper 1983), so that S carries the presupposition content specified in (13). However, this prediction appears incorrect. The question in (12) may presuppose that some member is female or perhaps, more specifically, that the discourse referent introduced by A’s statement is female, but surely not that all members are female.

(13) \( \pi(S)(x)(w) \leftrightarrow x \text{ is female in } w \)

Analogous observations hold for the discourses in (14) and (16). In these cases, the wh-phrase’s scope carries the presuppositional content specified in (15) and (17), triggered by the definiteness of their and the factivity of know, respectively. The universal projection generalization accordingly leads one to expect that B’s question presupposes that each of the colleagues has Australian relatives and that each of those 50 runners will be disqualified. Once again we take those predictions to be incorrect. In each case, the attested presupposition seems, again, to be existential, or, perhaps, more specifically a presupposition about the discourse referent introduced by A’s existential statement.

(14) A: Some of the colleagues brought their Australian relatives to the meeting.
    B: Which [R of the colleagues] ([S brought their Australian relatives])?

(15) \( \pi(S)(x)(w) \leftrightarrow x \text{ has Australian relatives in } w \)

(16) A: Some of those 50 runners know that they will be disqualified.
    B: Which [R of those 50 runners] ([S know that they will be disqualified])?

(17) \( \pi(S)(x)(w) \leftrightarrow x \text{ will be disqualified in } w \)

What are the implications of these observations for the local context account, which is designed to deliver the universal projection generalization? The account can conceivably be reconciled with the data above by appealing either to tacit restriction of the wh-phrase’s domain (e.g. George 2011) or to local accommodation in the sense of Heim (1983). Tacit domain restriction could strengthen the restrictor property of the question in (12), so that the universally projected presupposition would merely entail that certain members are female, not that all members are. Likewise for the questions in (14) and (16). Alternatively, local accommodation could be posited to obviate projection, thereby also accounting for the absence of the problematic universal presuppositions in the relevant examples.

We doubt, however, that either tacit domain restriction or local accommodation is part of the
correct analysis of the non-projection data presented above. In alignment with experimental findings reported in Chemla (2009) and Geurts and van Tiel (2016), it seems to us that tacit domain restriction is hard or impossible in cases where which combines with a partitive of the form of Def Num NP (where Def is a definite or demonstrative determiner, Num is a numeral, and NP is a noun phrase). Example (16) illustrates that non-universal projection is found in particular in cases of this form, suggesting that tacit domain restriction is at least insufficient to capture the observed absence of universal projection. With regard to local accommodation, we note that this process, if posited in wh-questions, must be tightly constrained. One reason is that the unavailability of local accommodation is an implicit premise of current analyses of the so-called factive island effect illustrated by (18), from Oshima (2007).

(18) *Who does Max know that Alice got married to on June 1st?

Oshima (2007) and Abrusán (2011) propose two different analyses on which factive island questions suffer from certain pathologies of meaning. We will not review these analyses here, but we note that under both accounts, the intended meaning pathology would be obviated by local accommodation of the factive presupposition. If either Oshima’s and Abrusán’s account is correct, then, local accommodation can be unavailable in wh-questions even if projection yields a pathological meaning. It would therefore be surprising if local accommodation were available in cases like those above, where there seems to be less pressure for universal projection to apply, given that it would not result in a comparable pathology.

Motivated in part by these doubts about the local context account, we will in the following explore an alternative approach to the presence and absence of universal projection in wh-questions, an approach whose central ingredient is a family of pragmatic question bridge principles.

4. Universal projection from three bridge principles

We propose to revise Guerzoni’s (2003) proposal by replacing the question bridge principle in (11) with a family of three pragmatic bridge principles: informally, the No Accommodation condition requires that a questioner avoid the need for accommodation of the presupposition of a possible answer, hence that answer presuppositions be either satisfied by common knowledge or else incompatible with it; the Restrictor Economy condition obligates the questioner to avoid possible answers whose presuppositions are incompatible with common knowledge; and the Restrictor Homogeneity condition demands that the questioner aims for the set of possible answers to be fully determined by common knowledge.

Maintaining the assumptions catalogued in (19a) and (19b), which repeat (10a) and (10b), and still assuming that question meanings map worlds to sets of propositions, these bridge principles can be explicated as the felicity conditions listed in (20). For wh-questions of the form \( wh R S \), under the Hamblin–Karttunen semantics in (10c), repeated in (19c), these conditions amount to those listed in (21).
(19) a. **Frege-Strawson view of presupposition**
\[ \pi(\phi) = \text{dom}(\llbracket \phi \rrbracket) \]
b. **Stalnaker’s assertion bridge principle**
\[ \phi \text{ is felicitous in } c \text{ only if } c \subseteq \text{dom}(\llbracket \phi \rrbracket) \]
c. **Hamblin-Karttunen semantics**
\[ \llbracket \text{wh } R \ S \rrbracket = \lambda w. \{ [S](x) \mid [R](x)(w) \} \]

(20) Q is felicitous in c only if
i. **No Accommodation**
\[ \forall p \{ c \subseteq \{ w: p \in Q(w) \} \rightarrow c \subseteq \text{dom}(p) \lor c \cap \text{dom}(p) = \emptyset \} \]
ii. **Restrictor Economy**
\[ \forall p \{ c \subseteq \{ w: p \in Q(w) \} \rightarrow c \cap \text{dom}(p) \neq \emptyset \} \]
iii. **Restrictor Homogeneity**
\[ \forall w, w' \{ w, w' \in c \rightarrow Q(w) = Q(w') \} \]

(21) \[ \llbracket \text{wh } R \ S \rrbracket \text{ is felicitous in } c \text{ only if} \]
i. **No Accommodation**
\[ \forall x \{ c \subseteq \llbracket R \rrbracket(x) \rightarrow c \subseteq \text{dom}(\llbracket S \rrbracket(x)) \lor c \cap \text{dom}(\llbracket S \rrbracket(x)) = \emptyset \} \]
ii. **Restrictor Economy**
\[ \forall x \{ c \subseteq \llbracket R \rrbracket(x) \rightarrow c \cap \text{dom}(\llbracket S \rrbracket(x)) \neq \emptyset \} \]
iii. **Restrictor Homogeneity**
\[ \forall w, w' \{ w, w' \in c \rightarrow \{ x: \llbracket R \rrbracket(x)(w) \} = \{ x: \llbracket R \rrbracket(x)(w') \} \} \]

Our central observation about these felicity conditions, established in detail in the Appendix, is that for wh-questions, under the Hamblin-Karttunen semantics assumed, the three bridge principles taken together have the consequence (22). Those principles, taken together, derive universal projection.

(22) **universal projection derived**
\[ \llbracket \text{wh } R \ S \rrbracket \text{ is felicitous in } c \text{ only if} \]
\[ c \subseteq \{ w: \forall x [\llbracket R \rrbracket(x)(w) \rightarrow w \in \text{dom}(\llbracket S \rrbracket(x)) \} \} \]

Before building on this result in the remainder of the paper, we note that, while we cannot offer a general theory of felicity conditions in which the particular bridge principles posited here can be embedded, these principles strike us as plausible conditions on prototypical question-answer exchanges. We take it to be natural that a questioner will strive to avoid the need to accommodate the presupposition of a possible answer (No Accommodation) and to restrict the answer space to only those propositions that are still live options in the conversation (Restrictor Economy).

As for Restrictor Homogeneity, we suggest that it provides a possible way of interpreting the familiar notion of D-linking introduced in Pesetsky (1987). Pesetsky notes: “When a speaker asks a question like *which book did you read?*, the range of felicitous answers is limited by a set of books both speaker and hearer have in mind. If the hearer is ignorant of the context assumed by the speaker, a *which*-question is odd”. Echoing related remarks in George (2011)
in a different context, we propose that Pesetsky’s observation can be understood as follows. It is very unlikely for the full extension of the bare noun book to be invariable throughout a context set. Hence it may at first seem unlikely for the question Which book did you read? to satisfy the Restrictor Homogeneity condition. However, this condition could well be met if the wh-phrase’s domain is tacitly understood by the interlocutors as restricted to a particular set of books, say the set of books on this shelf that the interlocutors are attending to. What we propose, then, is that D-linking is tacit restriction of the wh-phrase’s domain that is driven by the pressure to meet Restrictor Homogeneity. The question left open under this line of thought, though, is what to make of Pesetsky’s proposal that D-linking is restricted to which-questions, excluding wh-questions with bare who or what. We return to this issue in section 5.3 below.

5. A typology of non-universal projection

While universal projection follows from the three proposed bridge principles taken together, it can be shown (as the reader is invited to confirm) that no two of these principles are sufficient to derive universal projection. We now note that while felicity conditions provide listeners with a guide to the speaker’s assumptions, the listener might under certain conditions take the speaker to act in violation of one of the felicity conditions. The assumption that one of the three felicity conditions in (20) is violated would result in the obviation of the inference of a universally projected presupposition. Below, we present data that we interpret as showing that, indeed, each of the three conditions in (20) is suspendable and that the suspension of any one of the three principles results in the expected absence of universal projection.

5.1. The No Accommodation condition suspended

We begin by revisiting the examples presented in section 3 above. We submit that the attested absence of universal projection in all of those cases has the same source, viz. a violation of the No Accommodation condition stated in (20)i. For illustration, we focus here on the question in (14)B, repeated below as (23). The restrictor property and the presupposition are as shown in (24) (where (b) repeats (15)).

(23) Which \([R_1 \text{ of the colleagues}] [S \text{ brought their Australian relatives}]\)?

(24) a. \([R_1](x)(w) ⇔ x \text{ is one of the colleagues in } w\)
b. \(π(S)(x)(w) ⇔ x \text{ has Australian relatives in } w\)

Consider now the type of scenario described in (25). Relative to this scenario, the question (23) would satisfy Restrictor Homogeneity (20)iii and Restrictor Economy (20)ii, but not No Accommodation (20)i.

(25) **Type 1 scenario**

it is common knowledge that the colleagues are \(r_1, \ldots, r_n\); for each of \(r_1, \ldots, r_n\), the questioner lacks an opinion about whether they have Australian relatives
It would satisfy Restrictor Homogeneity because common knowledge fully determines the set of colleagues. It would satisfy Restrictor Economy because for each member \( x \) of that set, the speaker’s belief’s, and hence common knowledge, is compatible with \( x \) having Australian relatives. But it would violate No Accommodation because for some (in fact, every) member \( x \) of that set, the speaker’s beliefs, and hence common knowledge, fails to entail that \( x \) has Australian relatives.

We believe that the question (23) indeed has acceptable uses in such a scenario. In fact, we take the discourse in (14) above, repeated here as (26), to make that point, since it is easy to imagine B’s question in (26) as occurring in a type 1 scenario (where common knowledge is now the common knowledge of A and B).

(26) A: Some of the colleagues brought their Australian relatives to the meeting.  
B: Which \([R] \) of the colleagues \([S]\) brought their Australian relatives?

On our analysis, this demonstrates that suspension of the No Accommodation condition is a possible source of the absence of universal presupposition projection in wh-questions.

5.2. Restrictor Economy suspended

We will present an observation suggesting that Restrictor Economy, too, can be suspended. We will make this case with respect to the question in (27), where the restrictor property is as in (28a), and the presupposition property, due to the factivity of \( \text{know} \), is as shown in (28b).

(27) Which \([R] \) of our players \([S]\) does Fred know __ scored in the last game?  

(28) a. \([R](x)(w) \iff x \text{ is one of our players in } w\)  
b. \(\pi(S)(x)(w) \iff x \text{ scored in the last game in } w\)

Consider now the type of scenario described in (29). Relative to this scenario, the question (27) would satisfy Restrictor Homogeneity (20)iii and No Accommodation (20)i, but not Restrictor Economy (20)ii.

(29) **Type 2 scenario**  
it is common knowledge that our players are \( r_1, \ldots, r_n \) \((n>3)\); for \( r_1, r_2, r_3 \), it is common knowledge that they scored; for \( r_4, \ldots, r_n \), it is common knowledge that they did not score.

The question would satisfy Restrictor Homogeneity because common knowledge fully determines the set of players. It would satisfy No Accommodation because for each member \( x \) of that set, either common knowledge entails that they scored in the last game, or it entails that they did not. But it would violate Restrictor Economy precisely because for some members \( x \) of the set, common knowledge entails that they did not score.
We suggest that the question in (27) is indeed usable in this type of scenario. To illustrate, it seems clear that (30) below can be a successful exchange embedded in type 2 scenario.

(30) A: Crazy Fred is turning into a real problem. Whenever he finds out that one of our players scored a goal in a league game, within a week or two he sends that player a threatening text message.

B: We need to protect our players! Which [R of them] [S does Fred know _ scored in the last game]?

Since common knowledge in the type 2 scenario is inconsistent with the potential universal presupposition, the mere acceptability of (30) is indicative of the absence of universal projection. We conclude that the suspension of Restrictor Economy is a second possible source of the absence of universal projection.³

5.3. Restrictor Homogeneity suspended

Finally, we submit that Restrictor Homogeneity, too, is subject to acceptable suspension, and that such suspension goes along with the expected absence of universal projection. We propose that “quiz show questions” routinely violate the Restrictor Economy condition. For example, we take it to be obvious that (31) could be appropriately posed by a TV show host to a candidate even when common knowledge fails to determine the set of Japanese Nobel prize winners. In particular, it seems clear that (31) would be usable in a quiz show setting that instantiates the type 3 scenario in (32).

(31) Which [R Japanese Nobel Prize winner] [S died last month]?

(32) **Type 3 scenario**

it is common knowledge that there are some Japanese Nobel Prize winners, but there is no x such that it is common knowledge that x is a Japanese Nobel Prize winner

In this scenario, not only does common knowledge fail to determine the set of Japanese Nobel Prize winners, in violation of Restrictor Homogeneity (20)iii, but common knowledge even fails to determine this set partially, as it fails to identify any individual as a Japanese Nobel Prize winner. It is because of that property of the scenario that No Accommodation (20)i and Restrictor Economy (20)ii are satisfied vacuously, as the universal quantification (20)i and (20)ii ranges over the empty set of propositions.

³It seems plausible to us that acceptable violations of Restrictor Economy can arise when speakers aim to satisfy a competing constraint that is incompatible with Restrictor Economy. In the analysis of (30) the competing constraint that comes to mind is Gricean brevity. The speaker could have avoided the violation of Restrictor Economy by using a restrictor like of the players who scored a goal in the last game instead of of them, but refrained from doing so in order to reduce utterance length or syntactic complexity. Cummins et al. (2013: 204) make a related observation that a speaker may choose to use a presupposition trigger and later explicitly deny the presupposition if the alternative to the trigger involves a circumlocution.
Consider now the variant of (31) shown in (33). Given the restrictor and the presupposition properties shown in (34), universal projection would yield the presupposition that every Japanese Nobel Prize winner has Australian collaborators.

(33) Which \([R \text{ Japanese Nobel Prize winner}] [S \text{ accused one of his Australian collaborators of plagiarism last month}]\)?

(34) a. \([R](x)(w) \iff x \text{ is a Japanese Nobel prize winner in } w\)
    b. \(\pi(S)(x)(w) \iff x \text{ has Australian collaborators in } w\)

It seems obvious that (33) in fact need not carry such a universal presupposition. As announced above, we propose attributing the absence of universal projection in this case to the suspension of Restrictor Economy.

Recall also our proposal from above that Pesetsky’s (1987) notion of D-linking can be understood as tacit restriction of a wh-phrase’s domain driven by the pressure to meet the homogeneity requirement. The question we left open is why obligatory D-linking would be restricted to which-questions, as Pesetsky proposed. The question is, in particular, why questions with bare wh-phrases who and what need not be D-linked. We cannot offer an explanatory answer to this question, but we note that under our interpretation, this restriction might indicate that Restrictor Homogeneity is not in fact a general condition on question use, but merely, for reasons that remain to be elucidated, a condition on the use of which-questions.4

If so, it is predicted that universal projection is systematically absent in wh-questions with bare who or what. It turns out that this prediction is compatible with judgments reported in the literature – simply because the cases used to illustrate universal projection in wh-questions happen to not include any questions with bare who or what (Schlenker 2008, 2009, Abrusán 2011, 2014, Nicolae 2015) . Consider, then, the question in (36), a variant of (2) above, which is repeated here as (35).

(35) Who \([R \text{ among those ten boys}] [S \text{ does Mary regret that Bill invited }_]\)?

(36) Who does Mary regret that Bill invited _?

We take it that judgments regarding universal projection are less clear for (36) than they are for (35). Under analyses that derive, or presuppose, the unqualified universal projection generalization (Schlenker 2008, 2009, Abrusán 2011, 2014), a natural interpretation of this finding is that,

4Typologically, the English contrast between D-linked which and non-D-linked what/who seems to be replicated in several different ways. For instance, French has been reported by Baunaz (2011: 203) to employ a special prosodic contour (slight fall rise accent) on wh-words to signal specificity, that is, that “the speaker has a very good idea that the interlocutor has a specific referent in mind”. Languages which have morphological markers triggering D-linking, such as Turkish on the account of Enç (1991), may use or not use those on wh-words depending on contextual factors (e.g. Kornfilt 2013). It remains to be seen if these contrasts translate into different behaviours with respect to presupposition projection.
while universal projection is actually present in (36), uncertainty about the wh-phrase’s domain renders the universal presupposition hard to detect. That is, proponents of these accounts could point out that it is expectedly hard to confirm whether (36) presupposes that Bill invited everyone, simply because it is unclear what individuals the universal quantification ranges over. In contrast, our own analysis leads us to propose that the uncertainty about the wh-phrase’s domain, via suspension of Restrictor Homogeneity, does not merely render universal projection hard to detect, but in fact preempts universal projection from taking place in the first place, in virtue of removing one of the premises that we consider necessary to derive it.

6. Conclusions

Building on Guerzoni (2003), we have attributed the universal projection of presuppositions in wh-questions, where observed, to the conspiracy of three question bridge principles. If, like other felicity conditions, these principles are violable under certain conditions, they predict a typology of possible instances of non-universal projection. For each principle, we have presented instances of non-universal projection that we attribute to the principle’s suspension.

This proposal leaves many questions unanswered. First, while we have offered instances of violations of each of the three felicity conditions, we have said little about what it is about the examples presented that allows for those violations, hence we have not pinpointed the ultimate source of the absence of universal projection in the relevant cases.

Second, the analysis is subject to an important limitation. Since it is based on felicity conditions on asking questions, in its present form it is not applicable to embedded questions. But presupposition projections can of course be observed to project from embedded questions as well. To illustrate, (38) embeds (2), repeated again as (37), under know.

(37) Who [R among those ten boys] [S does Mary regret that Bill invited _ ]?

(38) Ann knows [who [R among those ten boys] [S Mary regrets that Bill invited _ ]].

It seems clear that, to the extent that (37) is intuited to presuppose that Bill invited each of those ten boys, so is (38). For the pragmatic bridge account to capture this parallel, or any projection of presuppositions from embedded questions, it would need to be suitably generalized. The prospects for that project remain to be assessed.5

Finally, we can pose an updated version of a question formulated at the end of section 3. There we asked how Schlenker’s (2008; 2009) local context account, which is designed to derive the universal projection generalization, could be rendered compatible with cases of non-universal projection. We noted that the effects of this theory could conceivably be weakened by appealing to tacit restriction of the wh-phrase’s domain (George 2011) or local accommodation (Heim 1983). In section 3, we already voiced doubts about the prospects of this approach. In addition,

5We thank Philippe Schlenker (personal communication) for pressing us on this point.
we now note that tacit domain restriction or local accommodation would need to selectively apply in the three type of scenarios that we have identified as supporting the suspension of one of the three question bridge principles. Under the local context account, the question that arises is why domain restriction or local accommodation would apply under just those circumstances.

Appendix

In this appendix, we wish to confirm that the three bridge principles posited in section 4 derive universal projection. Assuming a non-empty context set \( c \), we first show that the conditions in (20), repeated in (39), jointly entail (40).

(39) \( Q \) is felicitous in \( c \) only if
i. **No Accommodation**
\[ \forall p [ c \subseteq \{ w : p \in Q(w) \} \rightarrow c \subseteq \text{dom}(p) \lor c \cap \text{dom}(p) = \emptyset ] \]
ii. **Restrictor Economy**
\[ \forall p [ c \subseteq \{ w : p \in Q(w) \} \rightarrow c \cap \text{dom}(p) \neq \emptyset ] \]
iii. **Restrictor Homogeneity**
\[ \forall w, w' [ w, w' \in c \rightarrow Q(w) = Q(w') ] \]

(40) \( Q \) is felicitous in \( c \) only if
\[ c \subseteq \{ w : \forall p [ p \in Q(w) \rightarrow w \in \text{dom}(p) ] \} \]

Proof: The statements in (i) and (ii) entail (A). Given (iii), and given that \( c \) is non-empty, \( \forall w [ w \in c \rightarrow p \in Q(w) ] \) and \( \exists w [ w \in c \& p \in Q(w) ] \) are equivalent for any \( p \), so (A) and (B) are equivalent. Since \( w \) does not occur on the right-hand side of the material implication in (B), (B) is equivalent to (C), which in turn is equivalent to (D). Since for any \( w \in c \), \( c \subseteq \text{dom}(p) \) entails \( w \in \text{dom}(p) \), (D) entails (E), and hence (F). QED

(A) \( \forall p [ c \subseteq \{ w : p \in Q(w) \} \rightarrow c \subseteq \text{dom}(p) ] \)
(B) \( \forall p [ \exists w [ w \in c \& p \in Q(w) ] \rightarrow c \subseteq \text{dom}(p) ] \)
(C) \( \forall p, w [ w \in c \& p \in Q(w) \rightarrow c \subseteq \text{dom}(p) ] \)
(D) \( \forall w [ w \in c \rightarrow \forall p [ p \in Q(w) \rightarrow c \subseteq \text{dom}(p) ] ] \)
(E) \( \forall w [ w \in c \rightarrow \forall p [ p \in Q(w) \rightarrow w \in \text{dom}(p) ] ] \)
(F) \( c \subseteq \{ w : \forall p [ p \in Q(w) \rightarrow w \in \text{dom}(p) ] \} \)

For wh-questions, under the Hamblin-Karttunen semantics, (40) amounts to (41) as intended, deriving universal projection.

(41) \( [ \text{wh } R \ S ] \) is felicitous in \( c \) only if
\[ c \subseteq \{ w : \forall x [ [ \text{R } ] (x)(w) \rightarrow w \in \text{dom}( [ \text{S } ](x))) ] \} \]

References

Schwarz, B. and A. Simonenko (2016). Two pragmatic accounts of factive islands. In B. Prickett and C. Hammerly (Eds.), *Proceedings of 46th annual meeting of the North East Linguistic Society* (NELS 46). GLSA (Graduate Linguistics Student Association), Department of Linguistics, University of Massachusetts.
Abstract. Based on a sample of seven languages, I show that the so-called modal inferences in ever free relatives (ignorance and indifference) are not universally available. The primary reading of ever free relatives crosslinguistically turns out to be a “non-modal” one, which is available to all languages under investigation. The implication is that if there is a modal inference triggered by the use of the ever-morpheme in FRs, the inference is likely to have a source external to the ever free relative (Lauer, 2009; Condoravdi, 2015; Hirsch, 2016). In line with this conclusion, I propose to generalize Hirsch’s (2016) analysis of ignorance ever free relatives, suggesting that all ever free relatives, no matter how they are ultimately interpreted, are instances of (un)conditionals + donkey-anaphoric definite descriptions.

Keywords: ever free relatives, (un)conditionals, definite descriptions, modal inferences, crosslinguistic semantics

1. Introduction

This paper aims to contribute to our understanding of the semantics of EVER FREE RELATIVES, illustrated by the examples in (1).

(1)  
   a. **Whoever brought the cake** is exceptionally talented.
   b. Sue was so hungry that she ate immediately **whatever they served her**.
   c. Dave always goes **to whatever party Lisa goes**.

Ever free relatives (henceforth eFRs) have attracted a lot of attention by semanticists thanks to the intriguing interpretive effects caused by the presence of the ever-morpheme. It is commonly assumed that the primary function of the ever-morpheme is to convey a so-called modal inference, particularly the inference that the speaker or some other agent does not know or care about the identity of the eFR referent, dubbed ignorance and indifference, respectively (Dayal, 1997; von Fintel, 2000; Tredinnick, 2005). Only some researchers (e.g., Lauer, 2009; Condoravdi, 2015) have entertained the idea that eFRs, particularly the so-called universal or free choice eFRs, can be genuinely “non-modal”. It is more common to assume that these eFRs are in fact a subspecies of indifference eFRs.

After I provide some background to the modal inferences of eFRs (§2), I turn to novel crosslinguistic evidence that challenges the common assumption that eFRs are primarily or even always modal (§3). Based on a small-scale crosslinguistic empirical survey involving seven languages, I demonstrate that what can be considered non-modal eFRs are available in all of them, but the so-called modal eFRs only in a proper subset of them. This result supports the recent trend of treating eFRs essentially as non-modal; whenever modality is conveyed, its source is external to the eFR (Lauer, 2009; Hirsch, 2016). I further provide some new arguments in favor of treat-

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1This paper is partly based on a small-scale empirical study. I’m very grateful to all the translators and participants (a comprehensive list can be found at https://osf.io/kq3ag).
ing eFRs as subkinds of (un)conditionals (following Hirsch 2016, who in turn is building on Rawlins 2013) and show that there are reasons to believe that all kinds of eFRs (not just ignorance eFRs) should receive this treatment (§4). An explicit analysis, closely following Hirsch’s (2016) proposal is also provided.

2. Background on the modal inferences of ever free relatives

Much semantic literature on eFRs converges on the idea that their raison d’être is to convey some modal inference (Dayal, 1997; von Fintel, 2000; Tredinnick, 2005). The so-called IGNORANCE INFERENCE is probably the best-known and most studied type of inference; consider the classical example (2), which conveys that the speaker does not know (is “ignorant” about) which movie is now playing at the Avon. In fact, the interpretation is even stronger—the speaker has no settled belief about the identity of the movie. This intuition is captured by the inference in (3): there are worlds in the speaker’s doxastic state that differ in the identity of the movie currently played at the Avon. The varying identity of the eFR referent is referred to—ever since Dayal’s (1997) seminal paper—as the VARIATION REQUIREMENT.

(2) Whichever movie is now playing at the Avon is making a lot of money.

(Dayal, 1997: 101)

(3) \[ \exists w, w'[w, w' \in \text{DOX}(w_0)(\text{SPEAKER}) \land \neg \exists x \text{PLAYING AT THE AVON}(w)(x) = \exists x \text{PLAYING AT THE AVON}(w')(x)] \]

As noted by Lauer (2009) and Condoravdi (2015), there is a subspecies of the ignorance inference, namely the IRRELEVANCE INFERENCE. This inference arises in cases where discourse participants fail to agree on the identity of the eFR referent but agree that the identity is irrelevant—can remain unsettled—for the purpose of the current discourse. In this case, the variation requirement is satisfied not with respect to the doxastic state of a single individual (both A and B can stick to their respective beliefs about the deadline), but with respect to the union of more doxastic states (or, more specifically, the context set). From now on, when I speak about ignorance, I silently assume ignorance or irrelevance.

(4) A: The deadline at the end of March is binding.
   B: But the deadline is at the end of April!
   A: Well, I think it’s March, but it doesn’t really matter now—whatever deadline is written on the syllabus is binding.

(adapted from Lauer, 2009: 39)

(5) \[ \exists w, w'[w, w' \in [\text{DOX}(w_0)(\text{SPEAKER}) \cup \text{DOX}(w_0)(\text{HEARER})] \land \neg \exists x \text{DEADLINE ON SYLLABUS}(w)(x) = \exists x \text{DEADLINE ON SYLLABUS}(w')(x)] \]

2The choice of the neutral term “inference” is intentional. The issue of the intended kind of inference will be addressed shortly.

3Ignorance is not strong enough because the speaker cannot follow up with … the movie is the Arrival even if she is wrong about that (if her belief is false). Another way of capturing the intuition is to say that the speaker knows that she doesn’t know. Despite these complications, I stick to the term ignorance.

4I have not encountered a language that would distinguish between the two formally or that would allow one but not the other reading.
Another type of well-studied inference is the **indifference inference**. Consider example (6), which implies that Zack voted indifferently—he did not care about the identity of the person that was at the top of the ballot. According to the influential proposal of von Fintel (2000), this inference is captured well by a counterfactual condition of the form ‘had there been somebody else (than in actuality) at the top of the ballot, Zack would have voted for him/her anyway’, expressed slightly more formally in (7). In this case, the variation requirement is satisfied with respect to counterfactual worlds.

(6) Zack simply voted for whoever was at the top of the ballot (namely Clinton).

(von Fintel, 2000: 32)

(7) \[ \forall w [w \in \text{BEST}(w_0) \land \exists x \text{ AT TOP OF BALLOT}(w)(x) \neq \exists x \text{ AT TOP OF BALLOT}(w_0)(x) \rightarrow \text{VOTED}(w)(\exists x \text{ AT TOP OF BALLOT}(w)(x))(\text{ZACK}) ] \]

An example of what is sometimes considered a non-modal eFR is provided in (8). Lauer (2009) argues that this type of eFR carries no conventional modal inference (whether ignorance or indifference) and that it is sufficient if (i) Parker wrote at least two different things in those days (9a) and (ii) that all the things that he wrote in those days were violent (9b).

(8) In those days, whatever Parker wrote was (always) violent.

(Lauer, 2009: 7)

(9) a. \[ \exists s, s'[s, s' < \text{THOSE DAYS} \land \exists x \text{ WROTE}(s)(x)(\text{PARKER}) \neq \exists x \text{ WROTE}(s')(x)(\text{PARKER})] \]

b. \[ \forall s[s < \text{THOSE DAYS} \land \exists x[\text{WROTE}(s)(x)(\text{PARKER})] \rightarrow \text{VIOLENT}(s)(\exists y \text{ WROTE}(s)(y)(\text{PARKER}))] \]

### 3. Modal inferences crosslinguistically

#### 3.1. Existing evidence

The existing literature on eFRs has a record of more or less episodic observations to the effect that modal inferences in various languages are not as freely available as they are in English. Von Fintel 2000: 38 reports Anna Szabolcsi’s (p.c.) observation that Hungarian eFRs lack ignorance and indifference eFRs altogether (and only have the “universal” (non-modal) ones). Giannakidou and Cheng (2006) report that Greek eFRs lack the ignorance reading, but do have

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5 The formalization in (9) is simplified and will be made more precise in section 4.

6 Anna Szabolcsi (p.c.) informs me that eFRs in Hungarian are formed by the addition of csak lit. ‘only’ after the relative wh-word; see (i).

(i) Meghívtam akit csak láttam. invited.1SG REL.who.ACC only saw.1SG

‘I invited whoever (≈ everyone) I saw.’

Hungarian cannot form ever wh-words in eFRs by using the free choice morpheme bár-/akár-, which can only attach to the interrogative wh-word (bárki/akárki ‘anyone’), but not the relative one (*bátrak*/*akátrak*). (Cf. Halm 2016, who shows that bárki can participate in the formation of unconditionals.) For discussion of these and related facts I’m grateful to Anna Szabolcsi, Julia Bacskai-Atkari, Aniko Csirmaz, Éva Dékány, and Beáta Gyuris.
the non-modal one (they are silent on the indifference reading).

(10) **Greek** (Giannakidou and Cheng, 2006: 166/169)
   
   a. ?#Opjadhipote jineka ine arxisindaktria aftou to periodikou, pire which:EVER woman is the editor this:GEN the:GEN magazine:GEN got ena vravio xthes vradi. ignorance
   
   a prize last night
   
   Intended: ‘Whichever (≈ The) woman (who) is the editor of this magazine got a prize last night.’
   
   b. Opjosdhipote irthe sto parti, efxaristithike. non-modal
   
   who:EVER came:3SG to.the party was.happy:3SG
   
   ‘Whoever (≈ Everyone who) came to the party had a good time.’

Eilam (2007) says about Hebrew eFRs that “examples [involving indifference] are easier to find and given a null context, the indifference reading will be the one preferred by speakers, *if the ignorance reading is available at all*. However, it is not the case that the latter is entirely impossible [...]” (my emphasis). Caponigro and Fălăuş (2017) demonstrate that Italian and Romanian eFRs also lack the standard ignorance and indifference readings, but do have the non-modal one, as illustrated for Romanian below.7

(11) **Romanian** (Caponigro and Fălăuş, 2017: ex. (47c), (51c), (48c))
   
   a. *Este usturoi în orice mâncare găêtește Bianca acum.* ignorance
   
   is garlic in EVER.what dish cooks Bianca now
   
   Intended: ‘There’s garlic in whatever dish Bianca is cooking now.’
   
   b. *În acel moment, am luat orice unealtă îmi era la îndemână, care s-a nimerit să fie un ciocan.* indifference
   
   in that moment have.1SG grabbed EVER.what tool me.DAT was at hand
   
   REL.REFL.-has happened SUBJ be a hammer
   
   Intended: ‘In that moment, I grabbed whatever tool was handy, which happened to be a hammer.’
   
   c. Este usturoi în orice mâncare găêtește Bianca. non-modal
   
   is garlic in EVER.what dish cooks Bianca
   
   ‘There’s garlic in whatever (≈ every) dish Bianca cooks.’

Balusu (2017) observes that Telugu utilizes three different morphemes, reserved for ignorance, indifference, and non-modal readings, respectively. It might be of significance that only the last type (called “quantificational” by the author) appears to form a genuine FR (the other two are correlates/unconditionals).

Based on the data and claims above, one could gain the impression that these languages (perhaps with the exception of Hebrew) simply have no definite eFRs, but only eFRs that are

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7 Caponigro and Fălăuş (2017) argue that Italian and Romanian eFRs—what they call “free choice FRs” (a term also used by Giannakidou and Cheng 2006, but in the sense of (non-modal) eFRs), are semantically more akin to subtrigged free choice items than to eFRs. In other words, they are claimed not to be definite descriptions, but rather quantificational expressions. For the purpose of this paper, I take Romanian eFRs to be standard eFRs, i.e., definites, see below.
genuine universal quantifiers.\textsuperscript{8} It turns out, however, that a definite construal is available in languages without ignorance and indifference eFRs. Consider the minimal pair in (12), where the minimal difference concerns tense—past in (12a) and future in (12b). Future tense appears to license the eFR, which receives an uncontroversial definite construal.

(12) \textit{Romanian (SURVEY)}
\begin{align*}
a. & \quad \text{*Ieri la ora 8, David s-a \texttt{uitat} la orice era pe HBO.} \\
    & \quad \text{yesterday at hour 8 D. \texttt{REFL}-has looked at EVER.what was on HBO} \\
    & \quad \text{‘Yesterday at 8, David was watching whatever they were showing on HBO.’}

b. & \quad \text{Disease la 8, David se \texttt{va uita} la orice va fi pe HBO.} \\
    & \quad \text{Tonight at 8, D. \texttt{REFL} will look at EVER.what will be on HBO} \\
    & \quad \text{‘Tonight at 8, David will be watching whatever (≈ the thing) they will be showing on HBO.’}
\end{align*}

Upon closer examination, we discover that even eFRs in simple present contexts turn out to have a definite reading. In the absence of the adverbial quantifier \texttt{întotdeauna} ‘always’, one might be under the impression that the eFR has a universal reading; however, this impression disappears in the presence of the adverbial, which, intuitively, “takes over” the universality, quantifying over situations such that in each of the situations, David eats the thing(s) that his girlfriend cooks for him. Therefore, there is empirical motivation to adopt Tredinnick’s (2005) proposal that quasi-universal eFRs in non-modal contexts are in fact definites in the scope of covert generic or iterative operators.

(13) \textit{Romanian (SURVEY)}
\begin{align*}
\text{La cină, David mănăncă (întotdeauna) orice îi găstește prietena lui.} \\
\text{at dinner D. eats always EVER.what him cooks girlfriend his} \\
\text{‘For dinner, David (always) eats whatever his girlfriend cooks for him.’}
\end{align*}

3.2. Crosslinguistic empirical survey

In order to have a more reliable overview of the crosslinguistic situation, I have conducted a small-scale crosslinguistic survey of seven languages, testing the acceptability and interpretation of eFRs in the following four contexts: a. habitual present, b. simple past, c. temporally punctual future, and d. temporally punctual past, illustrated in (14). The former two lend themselves to iterative / quasi-universal readings; the latter two do not.\textsuperscript{9}

(14) \begin{align*}
a. & \quad \text{Mark (always) eats whatever his girlfriend cooks.} \\
    b. & \quad \text{Last week, Mark ate whatever his girlfriend cooked.}
\end{align*}

\textsuperscript{8}The hypothesis that at least some eFRs are genuine universal quantifiers used to be quite popular, if not standard (see e.g. Cooper 1983; Larson 1987; Tredinnick 1995; Iatridou and Varlokosta 1998). Ever since Jacobson’s (1995) seminal paper on the semantics of free relatives, however, the field has been dominated by the assumption that all FRs, including eFRs, are definite descriptions (see esp. the arguments in Tredinnick 2005).

\textsuperscript{9}More contexts were tested, but only these are systematically reported here. More detailed information on the survey (including the list of all participants, who were mostly linguists), blank as well as filled out questionnaires, and a spreadsheet summarizing the results can be found at https://osf.io/kq3ag.
c. Tonight at 8pm, Mark will watch whatever they’ll be showing on HBO.
d. Yesterday at 8pm, Mark watched whatever they were showing on HBO.

Table 1 provides the median ratings per context and language (Likert scale from 1/unacceptable to 5/acceptable; $n$ indicating the number of participants). The results show that eFRs are universally accepted in contexts allowing for iterative/quasi-universal interpretations (a, b). In context (b), which in principle allowed a single event or an iterative reading, the preferred reading (and in some languages the only one) was the iterative one, i.e. multiple instances of cooking–eating. eFRs are further generally accepted in the punctual future context. This suggests that despite the fact that the preferred/only reading in the simple past context is iterative (quasi-universal), the definite reading is generally available in the future context. In other words, all languages behave as Romanian as exemplified in (12b). The most interesting observation is that all the languages exhibit a decrease in acceptability in the punctual past context, as compared to the punctual future context. (The number of participants is too small for any statistical analysis to be meaningful.) This decrease is very slight (not greater than 1 point on the Likert scale + absolute rating above 3) in three of the investigated languages, namely Serbian, Polish, and Hebrew, while it is clearly pronounced (not smaller than 2 + absolute rating 2 or lower) in the other four languages—Greek, Russian, Czech, and Romanian. Let us call these CAT(EGORY)1 and CAT(EGORY)2 languages, respectively.\footnote{In the Greek survey, 3 of the 6 speakers rated context (d) with 1 (clearly in line with CAT1 language speakers), while the other 3 speakers with 3 or 4 (possibly in line with CAT2 language speakers). In other languages, the rating of context (d) was more consistently low.}

<table>
<thead>
<tr>
<th>Context</th>
<th>Serbian $n = 4$</th>
<th>Polish $n = 5$</th>
<th>Hebrew $n = 4$</th>
<th>Greek $n = 6$</th>
<th>Russian $n = 5$</th>
<th>Czech $n = 4$</th>
<th>Romanian $n = 4$</th>
</tr>
</thead>
<tbody>
<tr>
<td>a  habitual present</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>4.0</td>
<td>5.0</td>
<td>5.0</td>
</tr>
<tr>
<td>b  simple past</td>
<td>5.0</td>
<td>5.0</td>
<td>5.0</td>
<td>4.0</td>
<td>4.0</td>
<td>4.5</td>
<td>4.5</td>
</tr>
<tr>
<td>c  punctual future</td>
<td>5.0</td>
<td>5.0</td>
<td>4.5</td>
<td>4.5</td>
<td>4.0</td>
<td>4.0</td>
<td>5.0</td>
</tr>
<tr>
<td>d  punctual past</td>
<td>4.5</td>
<td>4.0</td>
<td>3.5</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
<td>1.0</td>
</tr>
</tbody>
</table>

Table 1: Median ratings of eFRs per context and language

It further turns out that CAT1 languages are not uniform with respect to the kind of reading that arises in the punctual past context. Serbian speakers accept both the ignorance and the indifference reading (confirmed in post-hoc p.c. with Boban Arsenijević); Polish speakers prefer the indifference reading (confirmed in post-hoc p.c. with Aleksandra Gogłoza); finally, Hebrew speakers prefer the ignorance reading (contra what is reported by Eilam 2007). The (un)availability of modal eFRs (for our purposes, eFRs in context (d)) also corresponds, by and large, to the (un)availability of single event readings in context (b). While speakers of CAT2 languages generally reject single event readings in context (b), speakers of CAT1 report that the single event reading in context (b) is available to them. The only exception is Polish, where 4 out of 5 speakers report the iterative reading as the only available one. This seems to suggest a borderline status of Polish, in which, possibly, the non-modal (iterative) reading is the only possible one if nothing speaks against it, while the modal (indifference) reading is available as a sort of last resort.
3.3. Discussion: What underlies the CAT1 vs. CAT2 distinction?

The hitherto published evidence as well as the present empirical survey clearly indicate that there are at least two categories of languages: CAT1 languages (English, Serbian, Hebrew, and Polish), whose eFRs are acceptable in punctual past contexts, conveying a modal inference (indifference and/or ignorance), and CAT2 languages (Greek, Russian, Romanian, and Czech), whose eFRs are not acceptable in punctual past contexts. It further seems evident that all languages, whether CAT1 or CAT2, allow for so-called non-modal readings, such as the quasi-universal iterative readings or definite readings, in case there is an appropriate licensing expression or operator, exemplified here by the future tense.

The existing literature as well as the present survey remain ambivalent as to which factor or parameter underlies the CAT1 vs. CAT2 division. I can think of two plausible candidates. The first option is that the relevant factor is semantics vs. pragmatics. The idea is that eFRs in CAT1 languages may satisfy the variation requirement “semantically”, i.e., by anchoring the variation to an object-language operator (such as a modal or aspectual operator), but also “pragmatically”, i.e., by anchoring the variation to the belief/epistemic states of discourse participants or to the common ground (this idea is defended for English by Lauer 2009). CAT2 languages, on the other hand, would only allow for the variation requirement to be satisfied “semantically”. If there is no suitable semantic operator (the case of punctual past contexts), the eFR is simply unacceptable.

The second option is that the relevant factor is epistemic (including doxastic) vs. root (or rather non-epistemic). The nature of this parameter could thus be either semantic or syntactic (assuming Hacquard’s 2010 approach to the epistemic vs. root distinction). The idea is that CAT1 languages allow variation within the domains of either epistemic or root/aspectual operators, whereas CAT2 languages only within the domains of root/aspectual operators. This approach is compatible with the assumption that all eFRs are licensed in the object language (i.e., “semantically”), which in turn entails that every utterance is in the scope of an implicit (speaker-related) doxastic operator (cf. Meyer, 2013), which, in the absence of any other suitable operator, generates the ignorance readings of eFRs.

In Šimík (2016: 123ff.), I showed that the situation in Czech might argue for the latter approach because explicit epistemic necessity modals do not seem to license eFRs. The present empirical survey contained a comparable condition and the results are suggestive of yet another parametric division. Russian and Greek seem to pattern with my intuition about Czech—the participants (who gave low ratings in context (d)) either found eFRs under epistemic modals unacceptable or, if they accepted them, they interpreted them iteratively, clearly suggesting that the epistemic modal is not the licensor. In Romanian and for three of the four Czech participants, on the other hand, eFRs are not only licensed under epistemic modals (median for Romanian: 4.75; median for Czech: 5.0), they also receive single event (definite) readings, suggesting that the epistemic modal can indeed license the eFR.11

11Cf. Fălăuş (2009), who shows that Romanian free choice/epistemic indefinite determiner vreun gets licensed by epistemic necessity modals.
In what follows, I put forth a unified “semantic” analysis of eFRs, building on Hirsch’s (2016) proposal on ignorance eFRs. I show how his proposal can be extended to non-modal eFRs and discuss some empirical implications.

4. Ever FRs as (un)conditionals + donkey definites

4.1. Basic idea and some arguments

Hirsch (2016) proposed that ignorance eFRs have a double syntactic and semantic life: on the one hand, they function as unconditionals (in the sense of Rawlins 2013; also called concessive conditionals), on the other, they function as donkey-anaphoric definite descriptions, picking up the referent introduced in the unconditional. An eFR like the one in (15a) receives the LF in (15b), where the unconditional (uC) denotes a set of propositions, pointwise restricting the universal doxastic operator (OP), and the free relative (FR), being part of the conditional consequent (nucleus of OP), denotes a definite description whose value equals the referent introduced by whatever in the unconditional. The LF is thus basically identical to the one of the unconditional in (15c).

(15) a. Sue ate whatever Dave cooked.
   b. \[OP [uC whatever Dave cooked]] Sue ate [FR whatever Dave cooked]
   c. Whatever Dave cooked, Sue ate it.

The motivation for treating eFRs as a subspecies of unconditionals is not just their morphosyntactic similarity, but also their interpretation, which involves (or can involve, in the case of eFR) the ignorance inference. This immediately raises the question whether Hirsch’s (2016) analysis can be extended to languages in which ignorance is not a possible inference conveyed by eFRs. In my opinion, such an extension is possible, if not desirable. Let us go through some suggestive arguments.

First, eFRs are known to differ from plain FRs in that they allow the use of complex wh-phrases, as shown in (16). The same contrast has been reported for Dutch (Groos and van Riemsdijk, 1981), German (Meinunger, 1998), Polish, Croatian (Citko, 2010), Italian (Caponigro, 2003), or Czech (Karlík, 2013), so it is clearly no accident, and it applies across different semantic types of eFRs.

(16) I’ll take which*(ever) book you give me.
   (adapted from Bresnan and Grimshaw, 1978: 335)

The unconditional / question-based analysis of eFRs makes it possible to view this contrast in terms of the function(s) played by the wh-expression in eFRs vs. plain FRs: while in plain FRs, the wh-expression is merely a relative operator, and relative operators are normally simplex, in eFRs, the wh-expression also plays the role of an interrogative phrase (being the locus of

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12The intimate relation between eFRs and conditionals was also noted by Baker (1995).

13In fact, this raises many more questions that are worth investigating, concerning how unconditionals and ever free relatives are related, morphosyntactically, as well as semantically, within individual languages.
variation in the set of propositions) and as such, it is free to be complex. The second argument, which reinforces the one just mentioned, comes from the asymmetry illustrated in (17): only plain wh-words can function as relative operators in (light-)headed relatives; ever wh-words cannot. This follows if wh-expressions in eFRs are not really relative operators.

(17) **Polish** (adapted from Citko 2004: 105)

Jan śpiewa to, {co / *cokolwiek} Maria śpiewa.
J. sings DEM what what.EVER M. sings
(Intended: ‘John sings what(ever) Mary sings.’)

Third, eFRs, as opposed to plain FRs, are unable to accommodate a contrastive topic–focus structure. The same holds of conditional antecedents and wh-questions (in Czech; not illustrated here). Apparently, all these structures are too “small” to be able to accommodate such peripheral phenomena as contrastive topic arguably is (see Rizzi 2001 for some relevant discussion).

(18) **Czech**

a. Vařili, co Karlovi_{CT} chutnalo_{F} (ale Marii_{CT} bohužel ne_{F}).
cooked what Karel:DAT tasted but Marie:DAT unfort. not
‘They cooked what Karel\textsubscript{CT} liked\textsubscript{F} (but Marie\textsubscript{CT} unfortunately did not\textsubscript{F}).’

b. Vařili, cokoliv Karlovi_{CT} chutnalo_{F} (\textit{*}{ale Marii bohužel ne}).
cooked what:EVER Karel:DAT tasted but Marie:DAT unfort. not
‘They cooked what Karel\textsubscript{CT} liked\textsubscript{F} (but Marie\textsubscript{CT} unfortunately did not\textsubscript{F}).’

Fourth, eFRs, as opposed to plain FRs, but like wh-questions and conditional antecedents (McDowell, 1987; Progovac, 1988; Drubig, 2001), cannot host epistemic modals.

(19) He does what(*ever) must be a difficult job.

(19) He does what(*ever) must be a difficult job.

(Tredinnick 1995; cited via Iatridou and Varlokosta 1998: 16)

Fifth, just like conditional antecedents, eFRs also exhibit a strong tendency towards syntactic and semantic dependency on the main (consequent) clauses in which they are embedded. The example in (19) is, I would say, one illustration of this: the eFR cannot host an independent epistemic modal because its very function is to restrict one. Non-modal eFRs, besides not being able to host epistemic modals, which is illustrated in (20), often exhibit temporal dependencies, such that the tense of the eFR should match the tense of the embedding predicate; see (21).

(20) **Czech**

Na dovolené ti budu vařit, co (*koliw) ti určitě bude chutnat.
on vacation you:DAT will:1SG cook what EVER you:DAT surely will taste
‘On vacation, I’ll cook for you what(ever) will surely taste good to you.’
The “dependent” character of eFRs (as opposed to plain FRs) is in some languages even built into the very morphosyntactic make-up of these constructions. An example is Bulgarian, which, lacking the ever-morpheme, uses the subjunctive to formally encode eFRs (Pancheva Izvorski, 2000). Similar observations, albeit less categorically, arguably apply to Hungarian, which also lacks the ever-morpheme in (e)FRs (see footnote (i)) and Greek, which does have it, but still opts for the subjunctive in many cases (Veronika Pleskotová, p.c.).

In summary, there are a range of arguments demonstrating (i) an asymmetry between eFRs and plain FRs and at the same time (ii) a similarity of eFRs to wh-questions and/or conditional antecedents. These arguments are valid also for languages which have no ignorance eFRs (such as Czech), suggesting in turn that eFRs in general—not just ignorance eFRs—are akin to questions and (un)conditionals.

By way of concluding this section, it is good to point out that the above-discussed classification of eFRs parallels the familiar and much discussed classification of conditionals into epistemic/truth conditionals (≈ ignorance/irrelevance eFRs), and content/situational conditionals (≈ non-modal eFRs); see Declerck and Reed (2001) or Haegeman (2003) for discussion and references and also Haspelmath and König (1998), who show that the same classification is also applicable to unconditionals. Indifference eFRs are, of course, reminiscent of yet another well-established category of conditionals, namely counterfactual conditionals (von Fintel, 2000). In terms of the epistemic vs. content conditional classification, indifference eFRs can probably fall into either of the two categories; see Tredinnick (2005), who distinguishes between internal and external indifference.

4.2. Ignorance eFRs

Let us now turn to how the (un)conditional-based analysis of eFRs is materialized. I start with spelling out Hirsch’s (2016) proposal on ignorance eFRs. I opt for a fully compositional treatment, which makes me introduce some elements beyond Hirsch’s (2016) proposal, but hopefully nothing that would affect the gist of it. Consider the LF in (22) and the associated semantic computation in (23).14

Let us go through the composition step-by-step. The basic meaning of the free relative is a property (23a) that gets shifted to a (maximal) entity—here the entity that Dave cooked, (23b)
(22)  Sue ate whatever Dave cooked.

\[
\langle s, \langle t \rangle \rangle \\
\{ \langle s, t \rangle \} \\
\{ \langle st, st \rangle \} \\
\text{OP} \\
\text{unconditional} \\
\langle st, \langle st, st \rangle \rangle \\
\{ \langle s, t \rangle \} \\
\langle \langle s, et \rangle, \{ \langle s, t \rangle \} \rangle \\
\text{property-core} \\
\langle \langle s, \langle e, t \rangle \rangle \rangle \\
\text{whatever}_2 \text{Dave cooked } t_2 \\
\langle d, \langle s, \langle e, t \rangle \rangle \rangle \\
\text{property-core} \\
\langle \langle s, e, t \rangle, \{ \langle s, t \rangle \} \rangle \\
\text{free relative} \\
\langle s, t \rangle \\
\langle \langle s, \langle e, t \rangle \rangle \rangle \\
\text{ate} \\
\langle d, \langle s, \langle e, t \rangle \rangle \rangle \\
\text{whatever}_2 \text{Dave cooked } t_2
\]

(23)  a.  \[[\text{property-core}]^g = \lambda s \lambda x [\text{COOKED}(s)(x)(\text{DAVE}) \land \text{THING}(s)(x)]\]

b.  \[[\text{free relative}]^g = \sigma x \text{COOKED}(g(3))(x)(\text{DAVE}) \land \text{THING}(g(3))(x)]\]

c.  \[[\text{unconditional}]^g = \lambda s [\text{COOKED}(s)(x)(\text{DAVE}) \land \text{THING}(s)(x)](SUE)]\]

d.  \[[\text{OP}]^g = \lambda p \lambda q \lambda s \forall w [w \in \text{DOX}(s)(\text{SP}) \land p(w) \to q(w)]\]

e.  \[[\text{unconditional}]^g = \{ \lambda s [\text{COOKED}(s)(x)(\text{DAVE}) \land \text{THING}(s)(x)] \mid x \in D_c \}\]

f.  \[[\text{OP}]^g = \{ \lambda q \lambda s \forall w [w \in \text{DOX}(s)(\text{SP}) \land \text{COOKED}(w)(x)(\text{DAVE}) \land \text{THING}(w)(x) \to q(w)] \mid x \in D_c \}\]

g.  \[[\text{OP}]^g = \{ \lambda s \forall w [w \in \text{DOX}(s)(\text{SP}) \land \text{COOKED}(w)(x)(\text{DAVE}) \land \text{THING}(w)(x) \to \text{ATE}(w)(\sigma y \text{COOKED}(w)(y)(\text{DAVE}) \land \text{THING}(w)(y))(SUE)] \mid x \in D_c \}\]

h.  \[[\forall]_p^g = \lambda p \lambda s \forall p [p \in P \to p(s) = 1]\]

i.  \[[\lambda]_p^g = \lambda s \forall p [p \in \{ [\lambda]_p^g \to p(s) = 1\}]

(see Jacobson 1995; Caponigro 2003).\footnote{The covert D I assume here corresponds to Schwarz’s 2012 definite article; it can readily be used for a situation-semantic analysis of donkey anaphora. I further follow Heim and Kratzer (1998) and assume that wh-words in relative clauses function as lambda-operators, which is indicated in (22) by the index 2. I do not address the question of how exactly this works compositionally.}  Node 4 denotes the proposition that Sue ate the thing(s) that Dave cooked, (23c). If the FR did not contain an ever-morpheme, we would be done with the computation of truth-conditions at this point. Because our FR does contain one,
however, its property-core is “used” once more, this time as a complement of an abstract Q morpheme, whose role is to turn properties to sets of propositions.\footnote{The question of how it happens that the property-core appears in two positions at LF is interesting and important, but orthogonal to our present purposes. I side with Hirsch’s (2016: fn. 8) opinion that Johnson’s (2012) approach to quantifier raising seems to be a good fit for the structural situation we are facing.} This gives rise to what I term here unconditional—the set of propositions of the form ‘Dave cooked x’, where x a member of some contextually determiner domain $D_c$.\footnote{I adopt the assumption that the set of propositions gets generated by Q from Hirsch (2016) and I do so for presentational reasons. Otherwise, I subscribe to the more standard idea that the source of alternatives is the wh-word itself (as e.g. in Beck 2006, among many others). Making this assumption explicit would complicate the syntax-semantics mapping (a “complication” that might in fact eventually come with empirical benefits; cf. the discussion around (16)). Concerning the nature of the individual alternatives in $D_c$, I do not assume any particular restriction on these; they can be open-ended (or even “widened”) and unknown to the discourse participants, but they can just as well constitute a closed set known to the discourse participants (see example (4), which illustrates the latter option).} The unconditional, or more precisely the individual propositions in the set it denotes, function as restrictors of the operator OP. The nature of this operator determines the reading of the eFR (ignorance, indifference, non-modal). Since our aim is to derive the ignorance reading now, I assume that OP in (22) is a speaker-related doxastic operator—a universal quantifier over speaker’s doxastic alternatives. As standardly assumed (in Kratzerian modal and conditional semantics; see Kratzer 2012), the operator takes two arguments—a restrictor, which codetermines its modal base (here the \textit{unconditional}), resulting in (23f), and a nucleus (here $\Theta$). The result (23g) is a set of propositions of the form ‘All worlds compatible with speaker’s beliefs where Dave cooked x are such that Sue ate x / the thing that Dave cooked’, for all $x \in D_c$.\footnote{For simplicity, I assume that the composition of OP (ordinary denotation) with the unconditional (Hamblin-style denotation; Kratzer and Shimoyama 2002) happens via Hagstrom’s (1998: 142) flexible function application.} The final step in the derivation is turning this set into an ordinary denotation, which is achieved by the (default) universal quantifier over Hamblin alternatives [$\forall$], which conveys that all the propositions in its argument are true (in some situation).

Suppose now for concreteness that there are two relevant alternatives in the context—\texttt{DISH}_1 and \texttt{DISH}_2. Then, the meaning of $\Theta$, applied to the situation $s_0$, is true iff all worlds compatible with the speaker’s beliefs in which Dave cooked \texttt{DISH}_1, Sue ate that dish, and all worlds compatible with speaker’s beliefs in which Dave cooked \texttt{DISH}_2, Sue ate that dish.\footnote{Rawlins (2013) argued that the alternatives are exhaustified (i.e. . . . Dave cooked only \texttt{DISH}_1, . . . . . . . Dave cooked only \texttt{DISH}_1 . . . ). I am leaving exhaustification out for presentational purposes.}

\begin{align*}
\text{(24)} & \quad \text{For } D_c = \{ \texttt{DISH}_1, \texttt{DISH}_2 \} \text{ and some situation } s_0, \llbracket \Theta \rrbracket^s(s_0) = 1 \text{ iff} \\
& \quad \begin{align*}
\text{a. } & \forall w [ w \in \text{DOX}(s_0)(\text{SP}) \land \text{COOKED}(w)(\texttt{DISH}_1)(\text{DAVE}) \\
& \quad \rightarrow \text{ATE}(w)(\sigma x \text{COOKED}(w)(x)(\text{DAVE})(\text{SUE})) ] \land \\
\text{b. } & \forall w [ w \in \text{DOX}(s_0)(\text{SP}) \land \text{COOKED}(w)(\texttt{DISH}_2)(\text{DAVE}) \\
& \quad \rightarrow \text{ATE}(w)(\sigma x \text{COOKED}(w)(x)(\text{DAVE})(\text{SUE})) ]
\end{align*}
\end{align*}

The benefit of this (i.e., Hirsch’s 2016) semantics is that it derives the ignorance inference effortlessly. The fact that the doxastic state of the speaker in $s_0$ is compatible with more than just one entity that Dave cooked boils down to saying that the speaker’s doxastic state is not settled on the issue of what Dave cooked. In other words, the speaker does not know (has no settled
belief about) what Dave cooked.\footnote{As noted already by Rawlins (2013) and reiterated by Hirsch (2016), it must be the case (it is presupposed) that each restrictor in the set denoted by the unconditional is true in at least one world of the speaker’s doxastic state (dubbed non-triviality).} This in turn has the positive outcome that one need not stipulate the variation requirement as an extra property of eFRs (cf. Dayal 1997 and subsequent literature). All that is needed is the empirically motivated assumption that eFRs—besides being FRs—are also unconditionals, which in turn obligatorily involve alternative denotations (more precisely, non-trivial alternatives, where $|D_c| > 1$). Since these alternatives “feed into” the doxastic operator, they automatically derive variation within the doxastic state; cf. Condoravdi (2015), who also utilizes alternative semantics for eFRs but does not seem to make the step towards abolishing the variation requirement as an extra condition on the use of eFRs.

Ever since von Fintel (2000) (see Lauer 2009 and Condoravdi 2015 for refinements) it has been known that the ignorance inference is not at issue (roughly in the sense of Simons et al. 2011), i.e., it cannot be negated or embedded by attitude predicates, for instance. In order to capture the not-at-issue nature of the ignorance inference, we have to assume that the operator OP in (22) cannot be negated or more generally embedded. I follow much recent literature and assume that the present doxastic OP is a sort of default operator attached to any matrix declarative (see e.g. Meyer’s 2013 Matrix K Theory). As such, it cannot be properly embedded (unlike its overt kin, the verb \textit{believe}), or at least not by overtly expressed operators.\footnote{Tredinnick (2005: Ch. 4) gives ample evidence of ignorance eFRs’ non-embeddability. She notes that there is a single exception, namely that ignorance need not be tied to the speaker, but also to a holder of an attitude expressed by a matrix attitude predicate.}

4.3. Non-modal eFRs

Let us now see how Hirsch’s (2016) analysis can be extended to non-modal uses of eFRs. I will provide an analysis of two examples from my empirical survey—eFRs in the future context—giving rise to a definite interpretation—and in the simple past context—giving rise to a quasi-universal/iterative interpretation. The LF in (25) differs in one crucial respect—the operator which “licenses” the eFR and takes it as its first argument (in its unconditional function) is not an implicit doxastic operator, but rather either (a) the future operator (FUT) or (b) the aspectual iterative operator (ITR).

The computation of the truth-conditions is parallel to the one in (23) and will not be repeated here. Of relevance is the denotation of FUT and of ITR, which is provided in (26). The semantics of FUT follows the spirit of Copley’s (2009) proposal, according to which the future is a modal with a metaphysical (circumstantial) modal base, yielding a set of worlds/situations that are possible continuations of the evaluation world/situation.\footnote{Notice that the circumstantial (root) nature of the licensing operator is crucial if the root vs. epistemic distinction is the relevant factor in licensing eFRs in \textsc{cat2} languages (see section 3.3); cf. Giannakidou and Mari (2018), who propose, contra Copley (2009), that the future is epistemic.} The semantics of ITR is based on the situation-semantic analysis of adverbial quantifiers like \textit{always} (see e.g. von Fintel 1994). It quantifies over minimal situations (not encoded in the formula for the sake of simplicity) which are part of the evaluation situation and introduces, in the nucleus of the quantifier, an ad-
(25) a. (Tonight) Sue will eat whatever Dave cooks.
b. (Last week) Sue ate whatever Dave cooked.

(26) a. \([\text{FUT}]^g = \lambda p \lambda q \lambda s \forall s_1 [s_1 \in \text{META}(s) \land p(s_1) \rightarrow q(s_1)]\]
b. \([\text{ITR}]^g = \lambda p \lambda q \lambda s \forall s_1 [s_1 \leq s \land p(s_1) \rightarrow \exists s_2 [s_2 \geq s_1 \land q(s_2)]]\]

In (27) are the resulting truth-conditions of (25a). Sticking to the same domain of two dishes, as in our previous example, the sentence is true in \(s_0\) iff in all the continuations of \(s_0\) in which Dave cooks \(\text{DISH}_1\), Sue eats that dish, and in all the continuations of \(s_0\) in which Dave cooks \(\text{DISH}_2\), Sue eats that dish. These truth-conditions capture the intuition that Sue will eat a single dish (or a single group of dishes, in case we allow for plural entities). This is because only one of the two possible continuations will actually be realized.

(27) **Non-modal future-related reading**

For \(D_c = \{\text{DISH}_1, \text{DISH}_2\}\) and some situation \(s_0\), \(\llbracket 1 \rrbracket^g(s_0) = 1\) iff

a. \(\forall s_1 [s_1 \in \text{META}(s_0)] \land \text{COOKS}(s_1)(\text{DISH}_1)(\text{DAVE}) \rightarrow \text{EAT}(s_1)(\sigma x \text{COOKED}(s_1)(x)(\text{DAVE})(\text{SUE})]\) &

b. \(\forall s_1 [s_1 \in \text{META}(s_0)] \land \text{COOKS}(s_1)(\text{DISH}_2)(\text{DAVE}) \rightarrow \text{EAT}(s_1)(\sigma x \text{COOKED}(s_1)(x)(\text{DAVE})(\text{SUE})]\)

The truth-conditions of (25b) are in (28). The sentence is true in \(s_0\) (say last week) iff all subsituations of \(s_0\) in which Dave cooked \(\text{DISH}_1\) are such that they extend to a supersituation in which Sue ate that dish, and all subsituations of \(s_0\) in which Dave cooked \(\text{DISH}_2\) are such that they extend to a supersituation in which Sue ate that dish. Since the quantified situations are actual situations, it follows that Dave actually cooked two dishes last week and that Sue...
actually ate both of them. This reading is thus truth-conditionally equivalent to the reading of a sentence containing a universally quantified DP (Sue ate everything that Dave cooked), which is a welcome result, given the common assumption in the past that eFRs are or at least can be universal quantifiers.\footnote{eFRs in iterative contexts actually pass many tests applicable to universal quantifiers. See Tredinnick (2005) for a solution of this problem compatible with the present approach.}

(28) Non-modal iterative reading
For $D_e = \{\text{DISH}_1, \text{DISH}_2\}$ and some situation $s_0$, $\llbracket 1 \rrbracket^\delta(s_0) = 1$ iff
\[
\begin{align*}
&\forall s_1(s_1 \leq s_0 \land \text{COOKED}(s_1)(\text{DISH}_1)(\text{DAVE}) \\
&\quad \rightarrow \exists s_2(s_2 \geq s_1 \land \text{ATE}(s_2)(\sigma x \text{COOKED}(s_2)(x)(\text{DAVE}))(\text{SUE}))] \land \\
&\forall s_1(s_1 \leq s_0 \land \text{COOKED}(s_1)(\text{DISH}_2)(\text{DAVE}) \\
&\quad \rightarrow \exists s_2(s_2 \geq s_1 \land \text{ATE}(s_2)(\sigma x \text{COOKED}(s_2)(x)(\text{DAVE}))(\text{SUE}))]
\end{align*}
\]

I conclude that Hirsch’s (2016) proposal for ignorance eFRs can be effortlessly extended to non-modal eFRs. The differences in meaning follow from the nature of the operator that quantifies over (“licenses”) the eFR in its unconditional function.

5. Conclusion

Ever since Dayal (1997), it has been common to assume that ever free relatives convey, in one way or another, a modal meaning—ignorance or indifference. This paper has delivered novel crosslinguistic evidence supporting the more recent view (Lauer, 2009; Condoravdi, 2015; Hirsch, 2016) that modal inferences are not really an integral part of the meaning of ever free relatives: four out of the seven investigated languages cannot even convey ignorance or indifference with their ever free relatives. In contrast, the so-called non-modal uses of ever free relatives, including the quasi-universal ones, are apparently universally available. I continued by delivering some old and novel arguments in favor of the hypothesis that ever free relatives are (un)conditionals of sorts (Baker 1995; recently Hirsch 2016). As (un)conditionals, ever free relatives can function as restrictors of various operators, which in turn derive the different readings that ever free relatives appear to have. The bottom line is: All ever free relatives are non-modal. Their apparent modality is the result of an interaction with certain operators, such as the implicit doxastic operator in ignorance ever free relatives.

The present paper leaves a lot of interesting questions open for future research. The most important one concerns the restriction of so-called modal uses in certain languages. What is it that prevents ever free relatives in these languages to convey the ignorance and/or indifference inference? I formulated two hypotheses, both of which receive a certain amount of empirical backing, but a principled explanation and reduction to an independent factor is still to be found. Resolving the question might also require the use of a more solid empirical methodology, as the judgments prove to be difficult, and there is a lot of cross-speaker variation within languages. It is unclear whether this variation is deeper or simply an artifact of an inadequate methodology. I further attempted to demonstrate that the (un)conditional / question-based approach to the syntax and semantics of ever free relatives opens up a whole new avenue of research into these and related constructions. Under this approach, ever free relatives are typically spelled out in their
“in situ” position (like quantifiers and unlike wh-phrases; cf. Johnson 2012), which is probably the reason why they have always been put on a par—syntactically—with plain free relatives. Yet, I provided multi-faceted evidence that ever free relatives (as opposed to plain free relatives) exhibit many formal and semantic properties that clearly reflect their “raised” syntactic position, where they denote propositions (rather than entities) and where they play the role of (un)conditionals / questions. The question is, therefore, which properties reflect which of both syntactic/semantic functions of ever free relatives and why this is so. The answers, possibly different for different languages, are likely to lead to new insights into how morphosyntax and semantics communicate with one another.

References


Alternating conj/disjunctions: the case of Japanese -toka and -tari
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Abstract. This paper investigates the interpretation of Japanese -toka and -tari, two non-exhaustive particles that receive conjunctive interpretations in upward-entailing environments, but disjunctive interpretations in downward-entailing and question contexts. We analyze -toka and -tari as items that introduce unstructured sets of alternatives in a Hamblin-style alternative semantics (Hamblin, 1973; Kratzer and Shimoyama, 2002), and derive their conjunctive and disjunctive readings via an interaction between these sets and the semantics of the environment containing them.

Keywords: -toka, -tari, Japanese, alternative semantics, conjunction, disjunction

1. -toka and -tari

-toka and -tari are used in unembedded declarative contexts to introduce non-exhaustive conjunctions of similar individuals and predicates, respectively. For example, (1a) is true if at least Taro and Hanako come, as well as if someone else, say, Jiro, comes, and is false if none or only one of those individuals comes. Likewise, (1b) is true if Taro cleaned his room, did the laundry, and did at least one other thing, such as some other household chore.

(1) a. Taro -toka Hanako-toka -ga ki -ta
   Taro -TOKA Hanako-TOKA -NOM come -PST
   ‘Taro, Hanako, and someone else came.’
b. Taro-wa heya-o sooji si -tari sentaku-o si -tari si -ta
   Taro-TOP room-ACC clean do -TARI laundry-ACC do -TARI do -PST
   ‘Taro cleaned his room, did the laundry, and did other such things.’

Although often encountered in coordinating constructions, both -toka and -tari may be used as stand-alone particles non-coordinatively, while still retaining their conjunctive and non-exhaustive interpretation, as demonstrated in (2).

(2) a. Taro -toka -ga ki -ta
   Taro -TOKA -NOM come -PST
   ‘Taro and someone else came.’
b. Taro-wa heya-o sooji si -tari si -ta
   Taro-TOP room-ACC clean do -TARI do -PST
   ‘Taro cleaned his room and did other such things.’

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These particles's ability to be used non-coordinatively distinguishes them from the nominal coordinator -ya, which also behaves as a non-exhaustive conjunction in upward-entailing contexts but requires two conjuncts (Hayashishita and Bekki, 2012; Sudo, 2014).

(3) a. Taro ya Hanako -ga ki -ta
    Taro YA Hanako -NOM come -PST
    ‘Taro, Hanako, and someone else came.’

b. *Taro ya (-ga) ki -ta
    Taro YA -NOM come -PST

Although these conjunctive readings are robust in (1) and (2), in the next section we show that this interpretation is not constant across environments.

2. Disjunctive readings of -toka and -tari

-toka and -tari do not display the conjunctive reading of (1) and (2) in all environments; in fact, they receive disjunctive interpretations in several semantic contexts. These environments are generally non-veridical or implicature-cancelling, and include negation, the antecedent of a conditional, imperatives, and polar questions. What is more, the disjunction is also non-exhaustive: it includes individuals/predicates that are not overtly mentioned, regardless of whether -toka and -tari are used coordinatively or not. As such, in the examples below, we include the second conjunct in parentheses to note that the disjunctive effect is observed in coordinative and non-coordinative uses. We discuss each of the environments in detail below.

2.1. Negation

Beginning with negation, we observe that (4a) is true if Taro studied neither English nor Spanish, nor anything else like that. Similarly, (4b) is true if Taro failed to clean his room, do the laundry, or any of his chores.

(4) a. Taro-wa eigo -toka (supeingo-toka)-o benkyoo si -nakat -ta
    Taro-TOP English-TOKA Spanish -TOKA -ACC study do-NEG -PST
    ‘Taro didn’t study English (or Spanish) or anything like that.’

b. Taro-wa heya -o sooji si -tari (sentaku-o si -tari) si -nakat-ta
    Taro-TOP room -ACC clean do-TARI laundry -ACC do-TARI do-NEG -PST
    ‘Taro didn’t clean his room (or do the laundry) or do anything like that.’

This interpretation is unexpected on an analysis of -toka and -tari as typical conjunctions; if they were conjunctive in this environment, we would expect (4a) to have the weaker meaning that Taro simply didn’t study every language, i.e. he only studied English, but not Spanish, rather than the actual interpretation of (4a), in which Taro has studied none of the languages at all.
2.2. Antecedent of conditionals

In the conditional in (5a), Yosuke will serve tea if Taro, Hanako, or someone else like them, such as their friend Jiro, comes. Likewise, in (5b), Taro’s mom will be happy if he engages in any healthy activity, such as drinking milk, eating an apple, or something similar to that.

(5)  
a. Taro-toka (Hanako-toka) -ga ki -tara Yosuke-wa ocha-o das -u  
   TARO-TOKA Hanako-TOKA -NOM come-if Yosuke-TOP tea -ACC serve-PRS  
   ‘If Taro (or Hanako) or someone like that comes, Yosuke will serve tea.’  
b. Taro-ga gyuunyuu-o non-dari (ringo-o tabe-tari) si-tara mama-wa yorokob-u  
   Taro-NOM milk -ACC drink-TARI apple-ACC eat-TARI do-if mom-TOP be.happy-PRS  
   ‘If Taro drinks milk (or eats an apple) or something like that, his mom will be happy’  

Here again, the interpretation of -toka and -tari is unexpected if they are interpreted conjunctively in these environments; in (5a), for instance, it is not necessary for Taro, Hanako, and someone else to come for Yosuke to serve tea.

2.3. Possibility modals

The disjunctive interpretation of -toka and -tari is attested in the scope of possibility modals as well, as (6) shows. In (6a), the lucky individual may receive a promotion or an overseas assignment, but not necessarily both. Likewise, Godzilla may engage in either action, or some other destructive act, but not necessarily both possible plans of attack.

(6)  
a. shoosin -toka (kaigaikimmu -toka) -ga ari-e -ru  
   promotion-TOKA overseas.assignment -TOKA-NOM be-POSS-PRS  
   ‘There is a possibility of promotion (or working abroad), among other things.’  
b. Gojira -wa machi-o hakai si-tari (teki -o taosi -tari) si -e -ru  
   Godzilla-TOP town -ACC destruction do-TARI enemy-ACC defeat-TARI do-POSS-PRS  
   ‘Godzilla may destroy the town (or defeat his enemies) or do other such things.’  

At this point it is worth pointing out potential objections to the claim that -toka and -tari receive an interpretation in the environments we have discussed here that is distinct from their interpretation in upward-entailing contexts. For one, one could argue that the apparent disjunctive interpretation of -toka and -tari under negation is simply due to their taking wide scope with respect to negation. Moreover, one might point out that conjunctions can be weakened in the antecedent of a conditional;\(^2\) (7), for example, is felicitous in English.

(7)  
If John and Mary come, I’ll serve tea. In fact, I’ll serve tea if John comes alone.

Finally, English and also permits the same kind of interpretation under a possibility modal that -toka and -tari do, as the modal can distribute over each conjunct. (8), for instance, does not require that John eat shrimp and crab in the same world, but simply that eating shrimp and eating crab are both possibilities for him.

\(^2\) We thank Rajesh Bhatt for bringing this objection to our attention.
John may eat shrimp and crab.

One can therefore question the claim that -toka and -tari alternate between a conjunctive and a disjunctive reading depending on their environment. Because of this, we consider the behavior of -toka and -tari in two more environments, imperatives and polar questions, arguing that their behavior in these contexts demonstrates more convincingly the variation in their interpretation.

2.4. Imperatives

In imperatives, disjunctive interpretations of -toka and -tari are readily available. In (9a), the addressee may satisfy the speaker’s request by bringing either food, drink, or some form of sustenance. Likewise, the speaker in (9b) is requesting some form of entertainment, and will be satisfied if the addressee performs at least one of the actions; they need not perform all of them.

(9)  
a. Tabemono -toka (nomimono -toka) motteko -i!  
food -TOKA drink -TOKA bring -IMP  
‘Bring me food (or drink) or something like that!’

b. Tsumaranai. Odot -tari (utat -tari) si-ro!  
boring dance-TARI sing-TARI do-IMP  
‘I’m bored. Dance (or sing) or something!’

It is harder to argue for a conjunctive interpretation of -toka/-tari here; if they were interpreted conjunctively, we would expect (9a), for instance, to only be satisfiable if both food and drink are brought to the speaker, but this is not the case. This context, therefore, provides a stronger case for the claim that -toka and -tari receive disjunctive interpretations in this environment.

2.5. Polar questions

Finally, disjunctive interpretations are also observed in polar questions. An affirmative response is felicitous in (10a) if only one of the people comes, and in (10b) even if only one of the actions is done.

(10) a. Taro-toka (Hanako-toka) -ga ki -ta no?  
Taro-TOKA Hanako-TOKA -NOM come -PST Q  
‘Did Taro (or Hanako) or someone like that come?’

b. Taro-wa heya -o sooji si -tari (sentaku-o si -tari) si -nakat-ta no?  
Taro-TOP room-ACC clean do-TARI laundry -ACC do-TARI do-NEG -PST Q  
‘Did Taro clean his room (or do the laundry) or something like that?’

Here again we find an interpretation that is consistent with a disjunctive treatment, but difficult to account for if -toka and -tari are in fact conjunctive. In particular, the felicity of an
affirmative response even if only one of the overtly mentioned conjuncts comes is unexpected if these particles receive a conjunctive interpretation.

Polar questions are especially useful for demonstrating the non-exhaustive nature of this disjunctive interpretation, and can be used to distinguish -toka/-tari questions from disjunctive polar questions using -ka ‘or’. (11), for instance, may be answered in the affirmative even if none of the overtly mentioned individuals came.

(11) Context: Taro, Ryo, and Jiro are all good friends, and everyone associates them with each other. There was a big party last night, and Hanako wants to know if any of them came. She asks:
   a. Taro-toka Ryo-toka-ga ki -ta no?
   b. Un, Jiro-ga ki -ta yo.
      Yes Jiro-NOM come -PST PRT
      ‘Yes, Jiro came.’

This differs markedly from a question using -ka, which may not be felicitously answered affirmatively if neither of the disjuncts came.

(12) a. Taro-ka Ryo-ga ki -ta no?
    b. #Un, Jiro-ga ki -ta yo.
       Yes Jiro-NOM come -PST PRT
       ‘Yes, Jiro came.’

This thus shows that the interpretation of -toka/-tari in these environments is crucially different from both conjunction and ordinary disjunction.

2.6. Interim summary

In this section, we have shown that -toka and -tari, though interpreted as non-exhaustive conjunctions in unembedded declarative contexts, receive a non-exhaustive disjunctive interpretation in a range of environments. In the next section, we develop an analysis of -toka/-tari that accounts for this alternation.

3. Analysis

Couching our analysis within a Hamblin-style Alternative Semantics framework (Hamblin, 1973; Kratzer and Shimoyama, 2002), we propose that -toka and -tari are both similarity-based alternative generators. More specifically, -toka and -tari denote sets of individuals and predicates, respectively, that are similar in the context to the overtly mentioned argument of -toka/-tari. By virtue of being self-similar, this set will always include the overtly mentioned argument itself. Denotations for -toka and -tari are given in (13a-b), and we additionally provide example sets of individual and predicate alternatives in (13c-d) to illustrate these denotations.
(13) Denotation and example alternatives for -toka and -tari

a. $\llbracket \alpha_{-\text{toka}} \rrbracket = \{ x \mid x \sim C \alpha \}$

b. $\llbracket \alpha_{-\text{tari}} \rrbracket = \{ P \mid P \sim C \alpha \}$

c. $\llbracket \text{Taro-toka} \rrbracket = \{ \text{Taro, Jiro, Ryo} \}$

d. $\llbracket \text{heya-o sooji si-tari} \rrbracket = \{ \lambda x.\lambda w.x \text{ clean the room in w}, \lambda x.\lambda w.x \text{ study English in w}, \ldots \}$

Because we analyze -toka and -tari as stand-alone alternative generating expressions, we follow Mitrović and Sauerland (2014) in making use of a silent coordinating Junction head, or simply J. This results in the syntactic structure in (14) for coordinative uses of -toka and -tari.

(14) -toka and -tari in a coordinate structure.

\[
\begin{tikzpicture}
  \node (JP) {JP};
  \node (toka/tariP) at (0,0) [below] {toka/tariP};
  \node (XP-toka/-tari) at (-1,-1) [below left] {XP-toka/-tari};
  \node (J) at (0,-1) [below] {J};
  \node (toka/tariP) at (1,-1) [below right] {toka/tariP};
  \node (YP-toka/-tari) at (2,-1) [below right] {YP-toka/-tari};

  \draw[->] (JP) -- (toka/tariP);
  \draw[->] (toka/tariP) -- (JP);
  \draw[->] (toka/tariP) -- (YP-toka/-tari);
  \draw[->] (toka/tariP) -- (XP-toka/-tari);
  \draw[->] (toka/tariP) -- (toka/tariP);
  \draw[->] (toka/tariP) -- (toka/tariP);
\end{tikzpicture}
\]

Semantically, we depart from Mitrović and Sauerland’s analysis of J in terms of set intersection, and propose instead that it denotes the union of the two sets of alternatives introduced by each coordinand. Essentially, J on this analysis behaves the same way or does according to Alonso-Ovalle (2006), collecting up the alternatives into a single set, and a similar, disjunctive J head has been proposed for Japanese -ka disjunctions by Uegaki (2018).

(15) Where $\llbracket \text{XP} \rrbracket$ and $\llbracket \text{YP} \rrbracket \subseteq D_t$, $\llbracket \llbracket \text{XP} [ \llbracket \text{YP} \rrbracket \rrbracket \rrbracket \rrbracket \rrbracket \subseteq D_t = \llbracket \text{XP} \rrbracket \cup \llbracket \text{YP} \rrbracket$

The alternatives compose with other elements of the sentence through Pointwise Functional Application (Hamblin, 1973), as defined in (16). This allows members of, say, a singleton set to compose with members of a non-singleton set by applying the member of the former to each member of the latter.

(16) If $\llbracket \alpha \rrbracket \subseteq D_{\alpha,\tau}$ and $\llbracket \beta \rrbracket \subseteq D_\alpha$, then $\llbracket \alpha(\beta) \rrbracket = \{ c \in D_\tau \mid \exists a \in \llbracket \alpha \rrbracket \exists b \in \llbracket \beta \rrbracket (c = a(b)) \}$

3 It may be necessary to place an additional restriction on J here, in order to capture the fact that the two phrases need to be similar to one another. This seems to be warranted anyway, as the null coordinator in Japanese has a similar effect to ya in expressing a non-exhaustive alternating conjunction/disjunction (Sudo 2014).

i) Taro, Hanako-ga ki -ta
   Taro Hanako-nom come-pst
   ‘Taro, Hanako, and someone else came.’

This could be analyzed as forming a set of alternatives that is restricted to being similar to both coordinands, as well as any alternatives introduced within those coordinands. We leave investigation of this possibility to future research.
Pointwise Functional Application involving sets of alternatives generated by -toka and -tari ultimately yields a set of propositional alternatives, as in (17).

(17)  a. \([\text{Taro-toka ga kita}] = \{\lambda w. \text{Taro came in } w, \lambda w. \text{Ryoichiro came in } w, \ldots\}\)  

       b. \([\text{Taro wa heya-o soojisi-tari sita}] = \{\lambda w. \text{Taro cleaned the room in } w, \lambda w. \text{Taro did laundry in } w, \ldots\}\)

What happens after the alternatives reach propositional status depends on the semantics of the environment in which they appear. Having developed the core of our analysis above, we turn now to each of these environments in turn.

3.1. Declaratives

Recall that in unembedded declarative contexts -toka and -tari are interpreted as non-exhaustive conjunctions, as in (1), repeated below as (18).

(18)  a. Taro -toka Hanako-toka -ga ki -ta  

       Taro -TOKA Hanako-TOKA -NOM come -PST  

       ‘Taro, Hanako, and someone else came.’  

       b. Taro-wa heya-o sooji si -tari sentaku-o si -tari si -ta  

       Taro-TOP room-ACC clean do -TARI laundry-ACC do -TARI do -PST  

       ‘Taro cleaned his room, did the laundry, and did other such things.’

We model this as the insertion of a universal quantifier over propositional alternatives, defined as in (19) following Kratzer and Shimoyama (2002).

(19)  \([\forall] (A) = \{\lambda w'. \forall p[p \in A \rightarrow p(w')]\}\)

Following previous work (Menéndez-Benito, 2005; Rawlins, 2008, 2013), we treat the universal propositional quantifier as inserted by default in order to reduce the set of alternatives to a singleton set, due to the presence of an assertion operator in the syntactic structure that requires a singleton set as an argument in order to be defined. Applying this quantifier to the set of alternatives in (17), for instance, results in the singleton set in (20).4

(20)  \{\lambda w'. \forall p[p \in \{\text{Taro came, Hanako came, Jiro came,} \ldots\} \rightarrow p(w')]\}\)

(20) states that sentence (18a) is true if each proposition in the alternative set holds in the world of evaluation.5 This is equivalent to asserting the conjunction of all of the alternatives

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4 For reasons of space we will restrict our analysis to either a sentence with -toka or one with -tari. The analysis is valid for both examples, regardless of which example we choose to illustrate the formal treatment.

5 One might worry here that the derived interpretation is too strong; it asserts that all the propositions in the set of alternatives are true, whereas the interpretation of sentences with -toka and -tari seems to be more accurately paraphrased as asserting that at least one alternative is true, in addition to the overtly mentioned alternatives. Given that the alternatives are constrained both by the similarity relationship and by the context, it is not clear that this would necessarily result in a significant increase in the number of alternatives relative to other possible analyses.
in the alternative set, and, therefore, this derives the conjunctive interpretation of unembedded declaratives with -toka and -tari.

3.2. Negation

The disjunctive interpretation of -toka and -tari can be straightforwardly derived by simply applying negation pointwise to each alternative, and then inserting the default universal propositional quantifier, just like in the analysis of non-negated declaratives. This results in (21).

\[
\{\lambda w'. \forall p \in \{\neg \text{Taro studied English, } \neg \text{Taro studied Spanish, } \ldots\} \rightarrow p(w')\}\]

This ensures that the negation of each alternative holds in the world of evaluation, and is equivalent to an analysis where conjunction takes wide scope over negation, thereby generating the reading by which Taro studied none of the languages in the set.

3.3. The antecedent of conditionals

For the analysis of conditionals, we follow the treatment of *if* conditionals in Alternative Semantics due to Alonso-Ovalle (2006) in analyzing the antecedent of a conditional as a universal quantifier over propositional alternatives that takes an argument a property of propositions, notated as \( f \). This is displayed in (22) below.

\[
\left[\text{Taro-toka Hanako-toka ga kitara}\right] = \{\lambda f.\lambda w. \forall p \in \{\text{Taro comes in } w, \text{ Hanako comes in } w, \ldots\} \rightarrow f(p(w'))\}
\]

The consequent of a conditional is then treated as the property of propositions, or a function from propositions into propositions. Assuming an implicit universal quantification over possible worlds in bare conditionals (Kratzer, 1986; Lewis, 1975), the consequent receives the following translation in (23).

\[
\left[\text{Yosuke-wa o-cha-o dasu}\right] = \{\lambda p.\lambda w. \forall w' [f_{\leq w}(p(w')) \rightarrow \text{Yosuke serves tea in } w']\}
\]

The antecedent then applies to the consequent, resulting in (24).

\[
\left[\left(\lambda w. \forall p \in \{\text{Taro comes in } w, \text{ Hanako comes in } w, \ldots\} \rightarrow \forall w' [f_{\leq w}(p(w')) \rightarrow \text{Yosuke serves tea in } w']\right)\right]
\]

Spelling this out in words, (24) says that for every proposition \( p \), if \( p \) is in the set of alternatives, then for every possible world, if \( p \) holds in a world close to the world of evaluation (notated \( f_{\leq w} \)), Yosuke serves tea in that world. This has the effect of distributing the propositions in the alternative set over the set of closest possible worlds, and therefore allows Yosuke to serve tea in worlds where Taro comes alone, in worlds where Hanako comes alone, and so on. In other words, this analysis captures the fact that it need not be the case that every proposition in the alternative set be true for Yosuke to serve tea. This
therefore successfully captures the disjunctive interpretation of -toka and -tari in the antecedent of a conditional.

3.4. Possibility modals

We provide a standard translation for the possibility modal -e as existential quantification over possible worlds, as in (25).

(25) \[ [-e] = \{ \lambda p. \lambda w. \exists w'[wRw' \land p(w')] \} \]

As with negation in (21), the possibility modal is applied pointwise to each proposition in the alternative set. The default universal propositional quantifier is then inserted to flatten the alternative set into a singleton, resulting in (26).

(26) \{ \lambda w''. \forall p[p \in \{ \lambda w. \exists w'[wRw' \land Godzilla destroys the town in w'], \lambda w. \exists w'[wRw' \land Godzilla defeats his enemies in w'], \ldots \} \rightarrow p(w'')] \}

According to (26), each of the modalized propositions in (26) holds in the world of evaluation. This results in an interpretation according to which each proposition holds in at least one world accessible from the world of evaluation, effectively distributing the propositions in the alternative set over the worlds accessible from the worlds of evaluation, as with the conditional case in (24). Crucially, this does not require that every proposition in the alternative set end up coming about in the actual world, nor does it require that every proposition hold at every possible world accessible from the world of evaluation. Rather, each proposition is merely an option.

3.5. Imperatives

We can extend the account given of possibility modals above to analyze imperative expressions, adapting ideas from Aloni (2007) into the single-tier alternative semantics framework in which we have couched our analysis. Concretely, we can treat the imperative operator as something akin to universal quantification of the set of alternatives, in combination with existential quantification over a set of worlds that encode the set of desires the imperative aims to satisfy. Applying this to (9a), repeated as (27a) below, we derive (27b) as its interpretation.

(27) a. Tabemono -toka (nomimono -toka) motteko -i!
    food -TOKA drink -TOKA bring - IMP
    ‘Bring me food (or drink) or something like that!’
    b. \{ \lambda w. \forall p[p \in \{ \lambda w'. you bring food in w', \lambda w'. you bring drink in w', \ldots \} \rightarrow \exists w'' \in W_{\text{Des}}[wRw'' \land p(w'')] \}

Breaking this down, (27) states that each proposition in the alternative set is associated with at least one world, accessible from the world of evaluation, where that proposition holds. Put another way, this can be thought of as meaning that any of the actions done in one of the
desire worlds satisfies the imperative. Just like in the possibility modal case, this does not require every proposition to hold in every world, and therefore we correctly predict a disjunctive-like interpretation for -toka and -tari with imperatives, where the imperative will be satisfied by any of the actions taken.

3.6. Polar questions

We conclude our analysis with polar questions. A recurrent theme throughout our analysis has been the application of a universal propositional quantifier over the set of alternatives. This, however, will not derive the correct results for polar questions; rather than universal quantification over the set of alternatives, it seems that we need existential quantification in order to capture the interpretation of -toka and -tari in polar questions. Fortunately, we can make use of the existential propositional quantifier defined by Kratzer and Shimoyama (2002), defined as in (28).

(28) \[\exists \] (A) = \{\lambda w'. \exists p[p \in A \land p(w')]\}

The insertion of a quantifier to flatten the alternative set into a singleton will be required by the partition operator, which takes a singleton set as argument and generates the bipolar denotation of a polar question.

(29) \[\text{Part}\{\lambda w'. \exists p[p \in A \land p(w')]\}\} = \{\lambda w'. \exists p[p \in A \land p(w')], \lambda w'. \neg \exists p[p \in A \land p(w')]\}

This brings about an interpretation for a question like (10a) to which one could answer ‘yes’ if one or more of the alternatives holds, and ‘no’ if none of them do. This delivers the correct disjunctive interpretation of -toka and -tari in polar questions.

One might ask why the existential propositional quantifier is inserted in this context, rather than the universal propositional quantifier. Empirically, of course, insertion of the universal quantifier delivers the wrong result, but we have not yet provided independent justification for the insertion of a different propositional quantifier. There are two possible ways to implement the selection of the right quantifier. One possibility is that this choice is essentially syntactic: the universal quantifier agrees with a declarative head \(C_{\text{decl}}\), while the existential quantifier is inserted to agree with the head responsible for generating polar question interpretations. Another option is that the choice is semantic in nature: the grammar inserts whichever quantifier produces the strongest meaning given the semantic environment. This is the tack taken by Davidson (2013) in her analysis of general use coordination in American Sign Language. In order for this approach to work in the case at hand, however, it would be necessary to guarantee that existential quantification really is stronger in polar questions, which, given the non-monotonic nature of questions, will not necessarily be the case. We leave further exploration of this issue to future research.

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6 We would like to thank Yuko Asada for bringing Davidson (2013) to our attention.

7 We thank Maribel Romero for discussion on this point.
4. Predictions

The account we have developed here makes additional predictions beyond the data it was designed to explain. We focus on three predictions here: 1) the behavior of -toka and -tari under necessity modals, 2) the context sensitivity of the non-exhaustive interpretation, and 3) the interpretation of a non-coordinative -toka/-tari question.

For the first case, our analysis predicts that -toka and -tari should possess conjunctive interpretations in the scope of necessity modals, just like in ordinary declaratives, but unlike the other contexts we have discussed. This is because the necessity modal, in combination with the default propositional quantifier inserted in declarative clauses, will require that each proposition in the alternative set hold in every possible world accessible from the world of evaluation. This predicted interpretation is given in (30) below.

(30) \{\lambda w. \forall p[p \in \{\lambda w'. \forall w''[w' \Rightarrow Godzilla destroys the town in w''], \lambda w'. \forall w''[w' \Rightarrow Godzilla defeats his enemies in w''], \ldots\} \Rightarrow p(w)]\}

This prediction is in fact borne out. As the -tari sentence in (31) shows, -tari does indeed receive a conjunctive interpretation in the scope of the necessity modal expression hitsuyoo-ga aru.

(31) insei-wa gakkai-de happyoosi-tari ronbun-o shuppansi-tari su-ru hitsuyoo-ga ar-u grad-TOP conf -at present -TARI paper-ACC publish -TARI do-PRS need -NOM be-PRT
‘It is necessary for graduate students to present at conferences and publish papers, etc.’

Another prediction of our analysis is that the non-exhaustive interpretation may vanish if the set of contextually salient similar alternatives only contains the overtly mentioned individuals or predicates. This is borne out as well: the non-exhaustive inference may in fact be directly cancelled, as (32) shows.

Taro-TOKA Hanako-TOKA-NOM come-PST in.fact Taro-and Hanako-only-NOM come-PST
‘Taro, Hanako, etc. came. In fact, only Taro and Hanako came.’

A final prediction of our analysis is that the non-exhaustive disjunctive inference should be available in non-coordinating uses of -toka and -tari. That is, we predict that one could felicitously answer ‘yes’ to the following question, modified from (11), even if the overtly mentioned individual did not come.

(33) Context: Taro, Ryo, and Jiro are all good friends, and everyone associates them with one another. There was a big party last night, and Hanako wants to know if any of them came. She asks:
   a. Taro-toka -ga ki -ta no?
   b. Un, Jiro-ga ki -ta yo.
      Yes Jiro-NOM come -PST PRT
‘Yes, Jiro came.’
The status of this prediction is not entirely clear. While the second author of this paper, a native speaker of Japanese, finds the discourse in (33) to be felicitous, other Japanese speakers find (33) infelicitous if Taro does not come. As such, there seems to be inter-speaker variation on this point. Our current account does not provide an explanation for the judgment of those speakers for whom (33) is infelicitous, and we therefore leave it as a puzzle for future research to address.

5. Conclusion

In this paper, we examined the semantic properties of the Japanese particles -toka and -tari. We showed that the interpretation of these particles is sensitive to their semantic environment: although they receive non-exhaustive conjunctive interpretations in unembedded declaratives, they receive a non-exhaustive disjunctive interpretation in a variety of other environments. Furthermore, this alternation between a conjunctive and a disjunctive reading remains regardless of whether the particles are used coordinatively or not. In order to explain this variation in interpretation, we developed an analysis in a single-tier Hamblin-style Alternative Semantics, treating -toka and -tari as introducing sets of similar individual and predicate alternatives, respectively. We then proceeded to derive the conjunctive and disjunctive interpretations through an interaction between the generated sets of alternatives and the semantics of the environment in which the alternatives appear.

Several issues remain to be explored in this line of research. For one, we would like to attempt to relate the work we have done on -toka and -tari to work that has been done on another Japanese non-exhaustive coordinator, -ya, which behaves much like -toka in that it takes nominals as arguments and alternates between a conjunctive and disjunctive interpretation in the same environments that -toka and -tari do (Sauerland et al., 2017; Sudo, 2014). Work on -ya primarily adopts an implicature-based approach: -ya is analyzed as a simple disjunction, identical in meaning to -ka ‘or’ discussed in example (12) in the current paper. It is then enriched and ultimately receives a conjunctive and non-exhaustive interpretation, through competition with either pragmatically enriched versions of -to ‘and’ and -ka ‘or’, as in Sudo’s (2014) higher-order implicature analysis, or with substring alternatives as in Sauerland et al.’s (2017) approach. Although we do not attempt it here, we are interested in reconciling our approach to -toka and -tari with these analyses of -ya.

An avenue of inquiry that may prove fruitful in shaping future work on these particles is an investigation of their interaction with quantificational elements in the sentence. For instance, we note that the sentence in (34) permits a reading in which Taro, Hanako, and anyone else in the context were seen by different children. It is judged true as long as Taro, Hanako, and possibly someone else are seen by at least one of the kids in the set. That is, the individuals in the set denoted by the -toka coordination may be distributed across the set of kids.

(34) subete -no ko -ga Taro-toka Hanako-toka -o mi -ta
all -GEN child -NOM Taro-TOKA Hanako-TOKA -ACC see-PST

8 We thank Katsuhiko Yabushita and Michael Yoshitake Erlewine for discussion on this point.
‘All the kids saw one of Taro, Hanako, etc.’

This is reminiscent of the interpretation of dependent plurals in English (Zweig, 2009); for instance, (35) is true even if each kid only flew one kite, as long as there are at least two kites flown overall.

(35) All the kids flew kites

It is not clear how our approach can handle cases like (34); the insertion of the default universal quantifier will result in too strong of an interpretation, in which every kid sees every one of the individual alternatives, but the insertion of the existential quantifier results in too weak of an interpretation that is satisfied if at least one of the individual alternatives is seen by every kid. However, it is not clear that an implicature-based approach, which would strengthen an underlying disjunctive meaning for -toka to a conjunctive one, would fare any better. We leave this interesting issue, as well as interactions with other quantificational elements, to future research.

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**good as a predicate of worlds**
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**Abstract.** The paper proposes a new semantics for *good*-predications involving finite *if*-and *that*-clauses. The proposal combines a standard semantics for conditionals with a standard semantics for the positive form of gradable adjectives and a minimal semantics for modal *good*. The predicted truth-conditions and conditions of use solve the mood puzzle presented in the first part of the paper. The remainder of the paper defends the classical notion of comparative goodness in terms of a comparison between possible worlds against Lassiter (2017)’s challenge.

**Keywords:** gradable adjectives, subjunctive conditionals, preference predicates, factivity.

1. **Introduction**

The topic of this paper are predicative constructions of the adjective *good* that involve *if*- and *that*-clauses with an indicative and past / subjunctive inflection related to the subject-position of *good*, as illustrated in (1).

(1) a. It is good that the cat is fat.
   b. It is good if the cat is fat.
   c. It would be good if the cat was / were fat.

For ease of reference, I will call these constructions “*good*-predications” and the finite clauses within “FIN-clauses”. The general pattern of these constructions is characterized in (2):

(2) $\alpha = \text{the cat be-INFL fat} \quad \text{FIN-clause}$

   a. It is $\text{good [ that } \alpha\text{-IND }]$.
   b. It is $\text{good [ if } \alpha\text{-IND }]$.
   c. It would be good [ if $\alpha\text{-PAST / SUBJ }$].

The main interest of this paper is the compositional semantics of *good*-predications and their interpretation at the syntax-semantics interface.

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1I’d like to thank Sigrid Beck, Hans-Martin Gärtner, Andreas Haida, Magda Kaufmann, Jan Köpping, Manfred Krifka, Clemens Mayr, Cécile Meier, Edgar Onea, Hazel Pearson, Uli Sauerland, Mathias Schenner, Viola Schmitt, Kerstin Schwabe, Ayaka Sugawara, Hubert Truckenbrodt, Dina Voloshina, Hedde Zeijlstra, Thomas Ede Zimmermann, Ilse Zimmermann, Sarah Zobel, the audiences at SuB22 in Potsdam/Berlin, and the 50th Mie U Linguistics Colloquium.

2. The conditional nature of good-predications

2.1. good is unlike likely

In recent work, Daniel Lassiter has argued that the FIN-clauses of good-predications should be analysed as propositional arguments of the predicate good (see Lassiter, 2017). His assumption is that—although there are differences between likely and good with respect to their characteristic properties as scalar adjectives—at the syntax-semantics interface likely and good behave exactly alike, i.e., they both take clausal arguments that are semantically interpreted as their propositional arguments. (3) and (4) give the relevant details in a very simplified form:

(3) a. It is likely that $\alpha$.
   $[\text{it is likely}_{(s,t),t} [\langle s,t \rangle \text{ that } \alpha]]$

b. It is good that $\alpha$.
   $[\text{it is good}_{(s,t),t} [\langle s,t \rangle \text{ that } \alpha]]$

(4) a. $[\text{likely}]^w = \lambda p_{(s,t)} \cdot \text{LIKELY}_w(p)$

b. $[\text{good}]^w = \lambda p_{(s,t)} \cdot \text{GOOD}_w(p)$

I think this parallel treatment is misguided for two reasons. First, the range of FIN-clause types in likely-predications differs from the range of FIN-clause types in good-predications: While likely only allows that-clauses (5), good also allows if-clauses in indicative and subjunctive mood (6).

(5) It is likely [ that the cat is fat ].

(6) a. It is good [ that the cat is fat ].
   that $\alpha$-IND
b. It is good [ if the cat is fat ].
   if $\alpha$-IND
c. It would be good [ if the cat was / were fat ].
   if $\alpha$-PAST / SUBJ

Second, that-clauses of good-predications are factive while that-clauses of likely-predications are not. Let’s assume Mary says: “I don’t know where John is.” Against the background of this utterance she cannot presuppose that John is at the office. Compare now the following utterances (where # marks the infelicity against the assumed conversational background):

(7) a. It is (not) likely that John is at the office.
   not factive
b. #It is (not) good that John is at the office.
   factive
c. It is (not) good if John is at the office.
   not factive

It seems that good and likely behave grammatically very differently. The obvious question with respect to the if-clauses in good-predications is: Is there a relation to conditionals? And if so, how close is it?

I want to mention two other respects in which good-predications differ from likely-predications that fit the grammatical pattern of good-predications as described above. First, we find non-conditional subjunctive mood with good-predications but not with likely-predications.

(8) It is good that your wedding be simple and make what is truly important stand out. http://www.usccb.org
2.2. *good*-predications have the outer appearance of conditionals

There are striking similarities between *good*-predications and conditionals. First of all, the pattern of “mood-matching” between the main predicate and the FIN-clause in *good*-predications mirrors the pattern of mood-matching between the antecedent and the consequent of conditionals, compare (10) with (11).

(10)  
   a. John will-IND like the picture, if the cat is-IND fat.
   b. John would-SUBJ like the picture, if the cat was-PAST / were-SUBJ fat.

(11)  
   a. It is-IND good, if the cat is-IND fat.
   b. It would-SUBJ be good, if the cat was-PAST / were-SUBJ fat.

As with conditionals, *would* seems to be dispreferred in the *if*-clause.

(12) Search results for the strings on Google:  
   a. “It would be better if you were”  67.400.000
   b. “It would be better if you would be”  0
   c. “It were better if you were”  10
   d. “It were better if you would be”  0

2.3. *good*-predications have the use conditions of conditionals

Another similarity between *good*-predications and conditionals is that they have the same conditions of use. Let me first introduce the conditions of use for conditionals as characterized by Kratzer (1979) (where *q* is the proposition expressed by *α* and *w* is the world where the utterance is performed):

(13) Rule of use for indicative conditional sentences – An utterance of *must* / *necessarily*, if *α*, *β* will only be appropriate if *q* and its negation are both compatible with what is common knowledge in *w*.

(14) Rule of use for subjunctive conditionals – An utterance of *would*, if *α*, *β* will only be appropriate if the negation of *q* is compatible with what is common knowledge in *w*.

(15) Rule of use for counterfactuals – The use of a subjunctive conditional sentence is a counterfactual use if and only if *q* is incompatible with what is common knowledge in *w*.

With non-conditional subjunctive mood we do not necessarily get a factive reading for the *that*-clause.

The second difference concerns the interaction with negation. Lassiter (2011) argues that *good* like *likely* is a neg-raising predicate. This seems to be at least doubtful for *good*-predications in subjunctive mood since the overt position of the negation affects the conditions of use. Let’s take the following utterance as part of the conversational background: “The cat is fat.” Against this background the sentences in (9a) and (9b) cannot be used interchangeably since their conditions of use are crucially different, cf. the test in Lassiter (2011).

(9)  
   a. It wouldn’t be good if the cat were slim.
   b. #It would be good if the cat weren’t slim.
To illustrate the conditions of use, Kratzer (1979) introduces the following story:

“The following story is reported about ancient Rome: When Caligula left the arena one day, suddenly the doors shut behind him and he was attacked by his own bodyguards. The crowd in the arena heard him screaming but they could only guess what had happened.”

Kratzer (1979)

From here on, I will modify her example slightly. Let’s assume that there are three possible outcomes of the story:

(16)   S1 = The doors open and the audience learns that Caligula is still alive.
      S2 = The doors stay closed and the audience won’t know what happened.
      S3 = The doors open and Caligula is found dead.

The following pictures represent what is common knowledge in the corresponding situations according to the outcomes characterized in (16).

![Diagram of S1, S2, and S3 situations]

Imagine now Tullius (who wants to get promoted) uttering the sentences in (17) in the different situations. If we check our intuitions about the appropriateness conditions for the different types of conditionals, we find the following:

(17)   a. [ Since Caligula is still alive ], I will get promoted.  \(\sim S1\)
      b. [ If Caligula is still alive ], I will get promoted.  \(\sim S2\)
      c. [ If Caligula were still alive ], I would get promoted.  \(\sim S2, S3\)

The table summarizes the use conditions dependent on the type of FIN-clause used.

<table>
<thead>
<tr>
<th>type of FIN-clause</th>
<th>form</th>
<th>appropriate in</th>
</tr>
</thead>
<tbody>
<tr>
<td>factive</td>
<td>since (\alpha)-IND</td>
<td>S1</td>
</tr>
<tr>
<td>indicative conditional</td>
<td>if (\alpha)-IND</td>
<td>S2</td>
</tr>
<tr>
<td>subjunctive conditional</td>
<td>if (\alpha)-SUBJ/PAST</td>
<td>S2, S3</td>
</tr>
</tbody>
</table>

Table 1: use conditions dependent on the type of FIN-clause

If we now turn to the different types of good-predications and check our intuitions about the appropriateness conditions, we find the same conditions of use depending on the type of FIN-clause used.
2.4. The puzzle: unconditionally good

Although good-predications look like conditionals and share their conditions of use, their truth-conditions crucially differ from conditionals: While any conditional interpretation of good-predications will result in a shifted interpretation for the predicate good, the predicate good in a good-prediction on the relevant reading is interpreted with respect to the world of evaluation. This is not to say that sentences of the form in (18b) and (18c) cannot have an interpretation as a true conditional. This interpretation is sometimes called the “logical reading”, Williams (1974), cf. (20a). On this reading the pronoun it is interpreted as anaphorically referring to some given situation in the discourse context. But this is not the relevant reading under discussion. There is agreement in the literature that the relevant reading is “non-logical” (see Pesetsky, 1991; Kaufmann, 2017b). According to a popular paraphrase for this reading, the proposition expressed by the antecedent of the conditional also plays the role of the propositional argument of good, cf. (20b). The example is taken from Kaufmann (2017b):

(20)  It would be good if Bill were here.
   a. logical reading:
      ‘If Bill were here it \[ ⇒ \text{the relevant situation} \] would be good.’
   b. non-logical reading:
      ‘If Bill were here \[ that Bill is here \] would be good.’"

At first sight, the interpretation suggested by this paraphrase seems to be a plausible candidate for the relevant non-logical interpretation. But this still doesn’t give us the right truth-conditions. To see this, I give a more explicit version of the logical form corresponding to the paraphrase in (20b) annotated with semantic types for the extensions of the expressions.

(21)  a. It is good if α.
   b. (if α) MUST \[ t \ [ \text{that} \ α \ ] \text{good}_{<(s,t),t>} \]

Independent of how one plans to spell out the truth-conditional contribution of the predicate good, it is clear from the LF that, since MUST is an intensional operator, we need to apply the rule of Intensional Functional Application to combine the intensional operator with a type t clausal argument (see Heim & Kratzer, 1998). This will result in a shifted interpretation for the predicate good in the sense of under such and such circumstances it is good that . . . . But what we want to say when we utter a sentence like (21a) in the unmarked case is that it is actually

---

3It has been observed for German that good-predications in subjunctive mood can occur with a V2-clause that is interpreted as an if-clause (see for example Meinunger, 2007).

(19)  Es wäre gut, er würde noch leben.
      ‘It be-SUBJ good he would-SUBJ still live
      ‘It would be good if he were still alive.’

The use of a V2-clause disambiguates in favour of the relevant reading under discussion.
good if certain circumstances turn out to be the case.\textsuperscript{4} The assessment of the goodness of the described circumstances is not shifted to another world. For example, the paraphrases in (22b) and (23b) readily have a cynical reading that welcomes Mary’s recovery only under certain conditions. But this reading doesn’t match the unmarked reading for (22a) and (22b).\textsuperscript{5}

(22) a. It is good if Mary will recover again.
   b. If Mary will recover again, [that she will recover again] is good.

(23) a. It would be good if Mary would recover again.
   b. If Mary would recover again, [that she will recover again] would be good.

In general, sentences of the form \textit{It is / would be good, if ϕ} in the unmarked case are used to express \textit{actual preferences} for certain conditions and \textit{not conditional preferences}. W.r.t. \textit{good}-predications in subjunctive mood the empirical findings can be restated as a puzzle:

(24) \textbf{The mood puzzle}

How can it be explained that the main predicate of a \textit{good}-predication in subjunctive mood (\textit{it would be good} on the unmarked interpretation) is overtly marked with subjunctive mood, when at the same time the world argument of \textit{good} doesn’t get a shifted interpretation.

The background for this puzzle is that in conditionals the world argument of a predicate that is overtly marked with subjunctive mood \textit{always} gets a shifted interpretation. This is true, both, for the antecedent and the consequent of conditionals. The question is: How can we account for the overt subjunctive marking of a predicate if its world argument doesn’t get a shifted interpretation? What we need is a compositional semantics for \textit{good}-predications that a) gives us the right distribution of the overt mood morphology b) makes sense of the use conditions associated with the different types of FIN-clauses and c) gets the unshifted interpretation of \textit{good} right, i.e., solves the mood puzzle.

3. The Proposal

The proposal has two parts: First, I propose that \textit{good}-predications involve conditional operators. This allows us to account for the mood distribution, the restriction of \textit{would} to the matrix-clause and the conditions of use associated with indicative and subjunctive mood. Both, with conditionals and \textit{good}-predications these properties can be uniformly attributed to the conditional operator involved. Second, I propose that modal \textit{good} denotes a relation between possible worlds. In particular, I will treat modal \textit{good} in parallel to Arnim von Stechow’s treatment of the temporal gradable adjective \textit{spät} in von Stechow (2006): While \textit{spät} is predicated of times, modal \textit{good} is predicated of worlds. As a consequence of this treatment, the modal operator and the \textit{good}-predicate have to be combined by Extensional Functional Application—instead of Intensional Functional Application—resulting in an unshifted interpretation of the (anchoring) world argument of modal \textit{good}.

\textsuperscript{4}The “unmarked case” is the case in which \textit{it} doesn’t get an anaphoric interpretation.

\textsuperscript{5}Similar observations have been made by Pullum (1987), Grosz (2012), Kaufmann (2017a).
The section is divided into five subsections: First, I introduce my assumptions about the interpretation of the conditional operator involved. Then, I present the semantics for good. In a third part, I show how the semantic composition of the conditional operator and modal good results in an unshifted interpretation for the world of evaluation of modal good. In subsection four, I discuss the predictions of this proposal for a simple example. In the last subsection, I summarize how the proposal accounts for the mood puzzle.

3.1. **good**-predications involve conditional operators

To be able to spell out the details of the proposal, I have to make some assumptions about the interpretation of conditionals. The proposal itself does not commit me to a particular theory. Any theory that explains the distribution of mood in indicative and subjunctive conditionals and accounts for their conditions of use will do. For the exploratory purpose of this paper, I choose to go with a basic Kratzer-style semantics for conditionals that takes conditional antecedents to be restrictors of overt or covert modal operators, Kratzer (1981, 2012). In (25), I give the general form of indicative and subjunctive conditionals on such an account.

\[(25)\]
\[
\begin{align*}
\text{a. } & (\text{if } \alpha) \text{ MUST } \beta \\
\text{b. } & (\text{if } \alpha) \text{ WOULD } \beta
\end{align*}
\]

For Kratzer, both MUST and WOULD are special cases of a modal necessity-operator NEC. NEC is interpreted relative to two conversational backgrounds \(f\) and \(g\), where \(f\) functions as the modal base and \(g\) as the ordering source, (26).\(^6\)

\[(26)\]
\[
\left[\text{NEC } \beta\right]^{f,g} = \lambda w. \forall w' \in \bigcap f(w); \exists w'' \in \bigcap f(w); w'' \leq_{g(w)} w' \land \forall w''' \in \bigcap f(w); w''' \leq_{g(w)} w'' \rightarrow \left[\beta\right]^{f,g}(w''')
\]

Kratzer (2012)

The contribution of the if-clause is that it adds another premise to the conversational background \(f\) that functions as the modal base (27).\(^7\)

\[(27)\]
\[
\left[\text{(if } \alpha) \text{ } \beta\right]^{f,g} = \left[\beta\right]^{f^*,g}, \text{ where } f^*(w) = f(w) \cup \{||\alpha||^{f,g}\}, \text{ for all } w \in W
\]

Kratzer (2012)

The resulting semantics for the general case is given in (28):

\[(28)\]
\[
\left[\text{(if } \alpha) \text{ NEC } \beta\right]^{f,g} = \lambda w. \forall w' \in \bigcap f^*(w); \exists w'' \in \bigcap f^*(w); w'' \leq_{g(w)} w' \land \\
\forall w''' \in \bigcap f^*(w); w''' \leq_{g(w)} w'' \rightarrow \left[\beta\right]^{f,g}(w'''), \\
\text{where } f^*(w) = f(w) \cup \{||\alpha||^{f,g}\}, \text{ for all } w \in W
\]

The differences between indicative (=MUST) and subjunctive (=WOULD) conditionals on Kratzer’s account come about by a particular choice for the modal base \(f\) and the ordering

\(^6\)\(w \leq_A w'\) iff \(\{p \in A : w' \in p\} \subseteq \{p \in A : w \in p\}\)

\(^7\)||\alpha||^{f,g} = \text{def } \{w \in W : [\alpha]^{f,g}(w)\}. \text{ If the interpretation of } \alpha \text{ is not sensitive to the conversational backgrounds } f \text{ and } g, \text{ I will simply write } ||\alpha|| \text{ instead of } ||\alpha||^{f,g}.
source \( g \). For example, under the assumption that the modal base \( f \) is an empty conversational background and the ordering source \( g \) is a totally realistic conversational background\(^8\), we get the following truth conditions for the subjunctive conditional in (29a):

\[
\begin{align*}
(29) & \quad \text{a. If Caligula was / were still alive, Tullius would be rich.} \\
& \quad \text{b. } \left[ \left( \text{if Caligula alive} \right) \text{ WOULD Tullius rich} \right]_{f,g} = \\
& \quad \quad \lambda w. \forall w' \in ||\text{Caligula alive}||: \exists w'' \in ||\text{Caligula alive}||: w'' \leq_{g(w)} w' \land \\
& \quad \quad \forall w''' \in ||\text{Caligula alive}||: w''' \leq_{g(w)} w'' \rightarrow \text{rich}_{w'''}(\text{Tullius})
\end{align*}
\]

‘Every \( ||\text{Caligula alive}||\)-world that is at least as close to an ideal determined by the facts in the world of evaluation \( w \) (represented by the set of propositions \( g(w) \)) as any other \( ||\text{Caligula alive}||\)-world is a world in which Tullius is rich.’

Against this background I propose the following logical forms for indicative and subjunctive \textit{good}-predications.

\[
\begin{align*}
(30) & \quad \text{a. It is good if Caligula is alive.} \quad \text{Indicative} \\
& \quad \text{b. } \left( \text{if Caligula alive} \right) \text{ MUST } [ \text{ POS good } ]
\end{align*}
\]

\[
\begin{align*}
(31) & \quad \text{a. It is would be good if Caligula was / were alive.} \quad \text{Subjunctive} \\
& \quad \text{b. } \left( \text{if Caligula alive} \right) \text{ WOULD } [ \text{ POS good } ]
\end{align*}
\]

The crucial differences between conditionals and \textit{good}-predications that result in an unshifted interpretation of the world argument of modal \textit{good} have to be attributed to the semantics of modal \textit{good}. This is the topic of the next section.

3.2. Modal \textit{good} as a predicate of worlds

\textit{Good} is a gradable adjective. Like other gradable adjectives it combines with a POS-morphem in its positive form. As a background for the discussion, I want to first introduce some assumptions about the semantics of gradable adjectives and their positive forms following von Stechow (2006).\(^9\)

3.2.1. Degree adjectives: \textit{tall}

I want to illustrate the assumptions that I take to be the background for the following discussion for the gradable adjective \textit{tall}. The semantics of the adjective \textit{tall} involves a measure function \textit{HEIGHT} that maps an individual to its maximal degree of tallness. \textit{Tall} denotes a relation between an individual \( x \) and a degree \( d \) such that the maximal degree of tallness of \( x \) given by

\(^8\)“A counterfactual is characterized by an empty modal base \( f \) and a totally realistic ordering source \( g \).” (Kratzer, 2012: p. 66)

\(^9\)As in the case of conditionals, the proposal in this paper is not committed to a particular semantics for gradable adjectives. Other proposals in the literature (see for example the references in von Stechow, 2006; Beck, 2010) would serve the purpose of this paper as well.
HEIGHT(x) is at least as high as d, cf. (32).10

(32) \[ \text{[tall}S]g = \lambda d: d \in g(S) \land g(S) \subseteq S_{\text{tall}}. \lambda x \in D_e. \text{HEIGHT}(x) \geq d, \]
where \( g(S) \) is a contextually salient subinterval on the tallness scale \( S_{\text{tall}} \).

Following von Stechow (2006), the positive form of the adjective introduces an operator POS. Semantically, POS specifies a neutral interval \( N(S) \) of degrees on the tallness scale \( S_{\text{tall}} \) that are neither short nor tall. The denotation of \[ \text{POS} \] when applied to an individual \( x \) returns true iff the maximal degree of tallness of the individual \( x \) is higher than any degree in the neutral interval \( N(S) \). On a reading for (34a) where Ede’s height is judged against the interval \( N(S) \) the sentence is true iff Ede’s maximal degree of tallness exceeds any degree of tallness in the contextually given interval \( N(S) \).

(33) \[ \text{[POS}_{N,S}g = \lambda A_{(d,t)} \cdot \forall d \in N(S): A(d) \] von Stechow (2006)

(34) a. Ede is tall. von Stechow (2006)
b. \( \text{POS}_{N,S} \lambda d. \text{tall}_S(d)(Ede) \)
c. \[ ([34b]) = 1 \text{ iff} \forall d \in N(S): \text{HEIGHT}(Ede) \geq d \]

3.2.2. Times as degrees: \textit{spät} (‘late’)

In von Stechow (2006), the gradable temporal adjective \textit{spät} (‘late’) is analyzed in analogy to \textit{tall} with the difference that \textit{spät} doesn’t relate an individual and a degree but instead two times.

(35) ‘late’: type \( \langle i, \langle i, t \rangle \rangle \) (official rule) von Stechow (2006)
\[ \text{[spät]} = \lambda t' \in I \subseteq T. \lambda t \in I. t \geq t' \]

The basic idea is that in the temporal domain times can treated as degrees (see the discussion in von Stechow (2006) for further details). Consequently, the temporal version of the POS-morphem according to von Stechow (2006) is a quantifier over times (as degrees):

(36) \[ \text{[POS}_{LN} = \lambda P_{(i,t)} \cdot \forall t \in N(I): P(t) \] von Stechow (2006)

The resulting semantics is illustrated for the example in (37).

10In this section, \[ [ \cdot ] \] is a function from expressions of English to their extensions – and not as before (and later on) to their intensions.
3.2.3. A minimal semantics for modal good

I propose that a relational semantics in the spirit of von Stechow’s semantics for spät can straightforwardly be transferred to modal good if we substitute worlds for times.\textsuperscript{11} Under this assumption, modal good simply expresses a relation between worlds according to an ideal specified by a contextually given conversational background $f$. The relevant conversational background can be deontic, teleological or bouletic (see Lassiter (2017) for a discussion of the range of possible readings). I want to call this the “minimal semantics” for modal good.\textsuperscript{12,13}

\begin{equation}
\begin{align*}
\text{Minimal semantics for modal good} \\
[\text{good}]^f = \lambda w. \lambda w'. \lambda w''. \, w'' \leq f(w) \, w'
\end{align*}
\end{equation}

As in the temporal case the corresponding POS-operator is sensitive for the ordering of its argument. I give the adjusted version for the POS-operator in the modal domain (=POS\textsuperscript{\leq}) in (40), where NEUTRAL\textsubscript{w,R} specifies the set of “neutral” worlds (that are neither good nor bad) in $w$ with respect to the given order relation $R$.

\begin{equation}
\begin{align*}
\text{POS}_{\leq} &= \lambda w. \lambda R. \lambda w'. \lambda w''. \forall w'' \in \text{NEUTRAL}_{w,R}: R(w'')(w')
\end{align*}
\end{equation}

The resulting semantics for POS\textsubscript{\leq} good is as in (41):

\begin{equation}
\begin{align*}
\text{POS}_{\leq} \text{good} &= \lambda w. \lambda w'. \forall w'' \in \text{NEUTRAL}_{w,\leq f(w)}: w' \leq f(w) \, w''
\end{align*}
\end{equation}

Good by itself is not a modal quantifier on the proposed account; but if we combine good with POS\textsubscript{\leq} the resulting semantics is the predicative core of an upper end degree modal in the sense of Kratzer (2012):

\textsuperscript{11}If we were to take degrees as equivalence classes of individuals (see Cresswell, 1976)), we could define a measure function \textsc{good}\textsubscript{$\leq$,f(w)} that maps a world to its corresponding degree (=equivalence class) according to the order relation $\leq f(w)$. This would allow us to restate the semantics of good in a more conventional format involving a measure function: $[\text{good}]^f = \lambda w. \lambda d. \lambda w'. \, \textsc{good}\textsubscript{$\leq$,f(w)}(w') \geq d$. With the right adjustments, this can be done without affecting the overall truth-conditions.

\textsuperscript{12}In analogy to the semantics of früh (‘early’) as the antonym of spät (‘late’), we can follow von Stechow (2006) and define the meaning of bad via the “internal negation” of good.

\begin{equation}
\begin{align*}
\text{bad} &= [\neg \text{good}], \text{where } [\neg] = \lambda w. \lambda R. \lambda w'. \lambda w''. \, \neg R(w')(w'')
\end{align*}
\end{equation}

\textsuperscript{13}Unlike Lassiter (2017), I do not assume that modal good needs any special treatment. What makes modal good modal is that it is predicated of worlds instead of individuals. I assume that the semantics of modal good is a special case of a general semantics for the gradable adjective good that covers the individual and the modal domain. Spacial restrictions prevent me from going into further details.
...a modal without dual could also be a degree expression covering the upper end of a scale of degrees of probabilities or preferences. Such upper-end degree modals could correspond to notions like, “it is (somewhat) probable,” or, “it is (somewhat) desirable.” We would then expect there to be a certain amount of vagueness with respect to the lower bound of the range of probabilities allowed.” (Kratzer, 2012: p. 46)

The vagueness mentioned by Kratzer can be attributed to the vagueness coming with POS\textsubscript{2}. If we apply the denotation of POS\textsubscript{2} good to a world \( w^* \), we get the truth conditions in (42).

\[
\{\text{POS}_2 \text{good}\}(w)(w^*) = 1 \text{ iff } \forall w' \in \text{NEUTRAL}_{w, f(w)}: w^* \leq f(w) w'
\]

For a case where this can be represented by Lewisian spheres (see Kratzer (1979) for a discussion when this is the case) and the predication is true this can be visualized as follows:

3.3. The composition

The standard mode of semantic composition that I’m assuming as a background for the discussion is Extensional Functional Application, as in (43), cf. Heim and Kratzer (1998).

\[
\{\alpha \beta\} = \lambda w. \{\alpha\}(w)(\{\beta\}(w))
\]

Intensional operators like modal necessity-operators usually combine with their prejacent by Intensional Functional Application for type reasons, cf. (45) under the assumption that \( [\text{NEC}]_{f,g} \) is of type \( \langle s, \langle s, t \rangle, t \rangle \).

\[
\{\alpha \beta\} = \lambda w. \{\alpha\}(w)(\{\beta\}(w))
\]

\[
[\text{NEC} \beta]_{f,g} = \lambda w. [\text{NEC}]_{f,g}(w)(\{\beta\}_{f,g})
\]

Crucially, in the case where the prejacent is \( [\text{POS}_2 \text{good}] \) IFA would result in a type mismatch since \( [\text{POS}_2 \text{good}] \) is of type \( \langle s, \langle s, t \rangle \rangle \). Here only EFA results in a semantically wellformed composition.
The result of the composition via EFA is as follows:

\[
\begin{align*}
\lambda w. \forall w' \in f^*(w): \exists w'' \in f^*(w): w'' &\leq \gamma_{(w)} w' \land \forall w''' \in f^*(w): w''' &\leq \gamma_{(w)} w'', \\
\forall w'' \in \text{NEUTRAL}_{w, \leq \gamma_{(w)}}: w''' &\leq \gamma_{(w)} w''', \\
\forall w''' \in \text{NEUTRAL}_{w, \leq \gamma_{(w)}}: w''' &\leq \gamma_{(w)} w''', \\
\text{where } f^*(w) &\in f(w) \cup \{||\alpha||/f_{g, h}\}, \text{ for all } w \in W
\end{align*}
\]

This is the general semantics for good-predications with if-FIN-clauses that I propose. As with conditionals, the differences between indicative and subjunctive good-predications are related to different choices for the conversational backgrounds \(f\) and \(g\). That \(\text{POS}_\square\text{good}\) can be thought of as the predicative core of an upper end degree modal can be seen now more clearly if we take a look at the special case where \(f\) and \(g\) are empty conversational backgrounds.

\[
\begin{align*}
\lambda w. \forall w' \in ||\alpha||: \forall w'' \in \text{NEUTRAL}_{w, \leq \gamma_{(w)}}: w' &\leq \gamma_{(w)} w''
\end{align*}
\]

‘Every \(||\alpha||\)-world lies above the neutral range of worlds according to an ideal determined by the conversational background \(h\) in the world of evaluation \(w\).’

3.4. The predictions

I want to illustrate the predictions of the theory for the example in (49).

(49) It would be good if Caligula were alive.

Let’s assume we are in S3 of (16): The doors of the arena open and Caligula is found dead. Let’s assume that, despite the tragedy of the circumstances, what is on Tullius’ mind in this situation is his plan to get promoted. He considers his chances: If Caligula were still alive, he would get the promotion that Caligula had promised him. But since Caligula is dead, his chances of getting promoted are unclear since the next ruler might have his own protégés. Against the background of these facts (represented by \(g\)) and his plan of getting promoted (represented by \(h\)), he utters the sentence in (49). The sentence is true in this situation if the following truth-conditions hold:

\[
\begin{align*}
\lambda w. \forall w' \in ||\text{Caligula alive}||: \exists w'' \in ||\text{Caligula alive}||: w'' &\leq \gamma_{(w)} w' \land \\
\forall w''' \in ||\text{Caligula alive}||: w''' &\leq \gamma_{(w)} w''' \land \\
\forall w'''' \in \text{NEUTRAL}_{w, \leq \gamma_{(w)}}: w'''' &\leq \gamma_{(w)} w''''
\end{align*}
\]

‘Every \(||\text{Caligula alive}||\)-world that is at least as close to an ideal determined by the facts in the world of evaluation \(w\)—represented by \(g(w)\)—as any other \(||\text{Caligula alive}||\)-world is a world that is at least as good according to an ideal characterized by Tullius’ plans in \(w\) of getting promoted—represented by \(h(w)\)—as any other world in a set of neutral worlds according to the same ideal.’

14
At first glance the predictions of this proposal seem to be notoriously vague. But notice that we have identified at least two elements in this construction that are independently known to be sources of vagueness: conditionals and the POS-operator. So every approach that wants to derive the truth conditions compositionally against the background of standard assumptions about these elements is in for a high degree of vagueness and context-sensitivity. In other words, the predicted vagueness and context-sensitivity is not a bug, it’s a feature.

3.5. Summary

The ingredients for the solution to the mood puzzle are: a) a standard semantics for conditionals b) a standard semantics for the POS-operator and c) a minimal semantics for modal good. Although good by itself is not a modal, the combination of modal good with the POS-operator results in a semantics akin to an upper end degree modal. This explains the modal character of good in its positive form. The similarities of good-predications to conditionals (the mood distribution, the restriction of modal would to the matrix clause and the conditions of use depending on the choice of mood) can be attributed to the conditional operator involved. The unshifted interpretation of the world of evaluation of modal good (that we observed in the unmarked case) is predicted on the minimal account for modal good since the semantic composition of the conditional with modal good calls for Extensional Functional Application for type reasons. The resulting semantics gives us reasonable truth conditions for good-predications that predict a certain degree of vagueness that can be traced back to the vagueness that we find with conditionals and the positive form of gradable adjectives.

4. Factive that-clauses as restrictors

What should we say about that-clauses? First, if the predicate good, as in the case of conditionals, is a predicate of worlds, then the factivity of good-predications with a that-clause cannot be attributed to the predicate good but has to be attributed to the that-clause. Second, the contribution of the rest of the construction including the that-clause cannot be a plain proposition for type reasons. One way to go would be to assume that a factive that-clause denotes a fact as a particular as proposed in Kratzer (2006). Another way to go is to assume that we do have a factive propositional that-clause after all: that α introduces the presupposition that \([α](w) = 1\), i.e., that α is true in the world of evaluation w. In addition, the that-clause restricts a covert

14In German, gut (‘good’) can sometimes have an interpretation in the sense of schon gut (‘good enough’, literally: ‘already good’). I want to call this a “sufficiency-interpretation”. Let’s assume a situation where 15-year old Karin says to her mother: ‘I have already cleaned my room. Shall I help you clean the kitchen?’ Her mother replies:

(51)   Nein. Es ist gut, wenn du dein Zimmer aufgeräumt hast.
   No. It is good if you your room cleaned have.

If we assume that there is a silent schon (‘already’) involved and give it a semantics in analogy to von Stechow (2006)’s semantics for schon spät (‘already late’), we get very good predictions for the sufficiency-interpretation.

Let me emphasize that the proposal is also compatible with a usage where good is used to express indifference as in the following example:

(52)   It is good if Mary is in town but it is also good if she isn’t. I don’t care.

Depending on the given conversational background an utterance of (52) could be used to communicate that Mary’s being in town won’t affect the success of my plans since everything has been sufficiently taken care of. Spacial restrictions prevent me from going into more detail on this point. I would like to thank Magda Kaufmann for pointing out to me examples of this kind.
modal MUST as in the case of indicative conditionals. This is what I’m going to assume here.\footnote{I follow the convention in Heim and Kratzer (1998) and add the factive presupposition after a colon.}

\[(53) \quad [(\text{that } \alpha) \text{ MUST } \beta]^{f,g,h} = \lambda w: [\alpha]^{f,g}(w), \forall w' \in \bigcap f^*(w): \exists w'' \in \bigcap f^*(w): w'' \leq_{g(w)} w' \land \forall w''' \in \bigcap f^*(w): w''' \leq_{h(w)} w'', \text{ where } f^*(w) = f(w) \cup \{||\alpha||^{f,g}\}, \text{ for all } w \in W \]

5. A remark on Percus (2000)’s Generalization X

In a nutshell: What allows us to solve the mood puzzle, i.e., account for the conditional nature of good-predications while at the same time to keep the world of evaluation for modal good unshifted, is the assumption that the conditional operator in good-predications is not used as an adverbial binder but as if it were an adnominal binder. This can be seen more clearly if we represent the world arguments directly in the syntactic structure as in Percus (2000).

\[(54) \quad \text{a. Conditional used as adverbial binder} \quad \lambda_1(\text{if } \lambda_2 [w_2 \text{ Caligula alive }] \text{ WOULD } w_1) \quad \lambda_3 [w_3 \text{ Tullius POS rich }] \\
\text{b. Conditional used as adnominal binder} \quad \lambda_1(\text{if } \lambda_2 [w_2 \text{ Caligula alive }] \text{ WOULD } w_1 \text{ WH } w_3) \quad \text{POS good} \]

The binding constellation in (54b) is in conflict with Generalization X from Percus (2000): “Generalization X: The situation pronoun that a verb selects for must be coindexed with the nearest \( \lambda \) above it.” Since the closest binder for the world argument that the predicate good selects for is the binder index of the relative pronoun WH3, the generalization seems to be violated. This is even more obvious in the reformulation of the generalization (Percus, 2000: p. 228) that directly refers to relative pronouns: “the relative pronoun whose movement makes the VP into a proposition must move from the situation position in the structure the verb projects”.

Under the perspective of the distinction in (54), we can add now the following amendment: “…except for when the predicate selects for another world argument in a thematic position.”

6. Lassiter’s challenge

The proposal as I have presented it so far is committed to the classical notion of comparative goodness as a comparison between possible worlds. Lassiter (2017) argues that any account based on this notion is doomed on principled grounds. In this section I want to a) introduce what I take to be the most challenging problem from Lassiter’s discussion, b) sketch Lassiter’s semantics for good and how it attempts to solve this problem, c) point out some problems for his proposal related to the data discussed in this paper, and d) suggest a new place where to look for a solution to his challenge. The main focus of Lassiter’s critique of the classical notion of comparative goodness are the accounts in Lewis (1973) and Kratzer (1981, 2012). As Lassiter (2017) shows, the degree scales that we derive from an order over possible worlds assumed by the classical proposals are not the right kind of scales that we need to account for the gradibility behaviour of modal good. Lassiter (2017) shows that good behaves like a relative adjective. To account for this behavior we need at least interval scales. The translation of the order relations
in premise and order semantics gives us ordinal scales at best. This objection directly carries over to the proposal in this paper. Here is a sketch of what Lassiter proposes to solve this problem. He starts out by characterizing a value function \( V \) which takes possible worlds to real numbers. \( V \) tells us “exactly how good it would be for the world to be like that”. The relevant notion of goodness could be moral goodness, instrumental goodness, desirability for a given individual etc. Since Lassiter assumes that the things that we predicate goodness and badness of are propositions, he needs a way to lift a scale representing the values of worlds to a scale representing the values of propositions:

“In decision theory, a standard way to do this is **expected value**: a weighted average of the values of the worlds in the proposition, representing our best guess about how good things will be if the proposition obtains. The weights are given by the conditional probabilities of the various worlds, assuming that the proposition obtains.

(7.22) The **expected value** of a proposition \( \varphi \), relative to a domain \( D \), is a weighted average of the actual values of worlds in \( \varphi \cap D \).

\[
E_V(\varphi) = \sum_{w \in \varphi \cap D} V(w) \times \text{prob}(\{w\} | \varphi \cap D).
\]

[... ] In many cases of interest, the domain \( D \) can be equated with the epistemically possible worlds.” (Lassiter, 2017: p. 187)

The function \( E_V \) is at the heart of Lassiter’s semantics for modal **good**. Let me comment on the four ingredients of this function from the point of view of the discussion in this paper. I will begin with the value function \( V \): This function is Lassiter’s first step to solving the scale problem. Nothing that I have said in this paper is in conflict with the assumption of a measure function \( \text{GOOD} \) (see footnote 11) that has \( V \) at its core. Second, the epistemic domain \( D \) that Lassiter refers to is naturally accounted for on this account by the conversational backgrounds of the conditional operators involved. Lassiter doesn’t discuss **good**-predications with subjunctive mood. But in analogy to the indicative case, I assume that a domain revision associated with subjunctive mood would also have to be attributed to the domain \( D \) as a part of the semantics of **good**. Here is a general argument from ellipsis that the interpretable feature associated with subjunctive mood couldn’t originate with modal **good**. We find **good**-comparatives with a factive and a counterfactual FIN-clause, (55). If the interpretable feature associated with the revision of the quantificational domain were associated with **good**, the condition of LF-identity for ellipsis would be violated, (55a). On the account in this paper, LF-identity is respected, (55b).[^16][^17]

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[^16]: Also, we would have to assume agreement from below.
[^17]: I assume that the interpretable features that license indicative and subjunctive mood originate with the conditional operator. We can think of MUST as NEC-Ind and WOULD as NEC-Subj, where “Ind” and “Subj” stand for the corresponding interpretable features.
Third, let’s consider the conditional probabilities. The data in this paper point to a problem for Lassiter’s account. Let’s assume we are in situation S3, cf. (16), in which it is common knowledge that Caligula isn’t alive anymore. Now consider an utterance of (56).

(56) It would be better if Caligula were still alive.

Since with the utterance of (56) against the assumed conversational background it is presupposed that Caligula is not alive anymore, the probability of Caligula being alive is 0. What I take this to show is that the assignment of probability—if probability assignments play a role—has to be sensitive to the conditions of use associated with the type of FIN-clause. If the corresponding semantic adjustements were attributed to the adjective good itself, we would run again in the problem from ellipsis mentioned above. The last aspect of the function $E_V$ at the heart of Lassiter’s proposal is the sum-function $\sum$. Here something very similar to what Lassiter has in mind is in reach for the proposal in this paper. What I haven’t considered so far is an alternative to the quantificational theory of conditionals: an account of conditionals that treats them as plural definite descriptions (see for example Schlenker, 2004). There is independent evidence that such an account is on the right track (see Schlenker, 2004). Under this assumption, the interpretation of a sentence like (57a) would be similar to a comparative sentence with plural definite descriptions as in (57b).

(57) a. It is better if it is raining than if it is snowing.

b. The girls are taller than the boys.

The sentence in (57b) can be true even if it’s not the case that for every girl it is true that she is taller than every boy. There is a discussion in recent literature how to account for the different readings of comparatives with plural DPs like (57b) (see Dotlačil and Nouwen, 2016 and the literature cited there). Dotlačil and Nouwen (2016) propose that we can account for them if we assume pluralities of degrees. Tools of this sort that have an independent motivation suggest that there might be a direct answer to the scale problem after all.\(^\text{18,19}\) My plea in this paper is that we shouldn’t dismiss the idea that good is predicated of worlds before we have explored all the theoretical options, in particular, before we have considered what the predictions are if we take into account recent developments in the semantics of conditionals and the semantics of comparatives with plural/quantificational DPs.

\(^\text{18}\)There are other relevant and important recent developments that could contribute to the proposal in this paper from the discussion of quantifiers in than-clauses, see for example Beck (2010). These considerations are directly relevant, if we stay with a quantificational theory of conditionals.

\(^\text{19}\)In Kaufmann (2017b) we find a proposal for good-predications in Japanese, approaching this topic from a propositional-argument-view, that arrives at a very similar conclusion as the account in this paper, if we switch from a quantificational analysis of conditionals to an analysis of conditionals as plural definite descriptions.
7. A few remarks on the similarities between good-predications and desire reports

The proposal in this paper derives truth conditions for good-predications that are very similar to the semantics that Heim (1992) assumes for desire reports. The basic idea of her proposal is that there is a “hidden conditional in every desire report”. The parallels can be seen very clearly if we take a look at her informal paraphrases (to which I added italics).

(58) a. John wants you to leave. \( \sim \) ‘John thinks that if you leave he will be in a more desirable world than if you don’t leave.’
    b. John wishes you were gone. \( \sim \) ‘John thinks that if you were gone he would be in a more desirable world than he is in because you are not gone’
    c. John is glad you are gone \( \sim \) ‘John thinks that because you are gone he is in a more desirable world than he would be in if you were not gone’

want corresponds to a good-predication with an if-FIN-clause in indicative mood, wish corresponds to a good-predication with an if-FIN-clause in subjunctive mood and glad corresponds to a good-predication with a that-FIN-clause in indicative mood. We even find a parallel in the conditions of use for the corresponding hidden FIN-clauses (which in case of the desire reports are relativized to the belief of the attitude holder).20 If we look at the details of Heim’s semantics, we see that the way the conditional combines with the desire predicate on her account corresponds to the proposed adnominal interpretation for the conditional.

(59) \( w \in \llbracket a \text{ wants } \phi \rrbracket \) iff for every \( w' \in \text{Dox}_a(w) \): \( \text{Sim}_{w'}(\llbracket \phi \rrbracket) < a, w \text{ Sim}_{w'}(W \setminus \llbracket \phi \rrbracket) \)

I want to mention two more parallels from German. In German, a counterfactual wish can be expressed either with wünschte (‘wish’) or wollte (‘want’). In both cases these verbs are overtly marked with subjunctive mood. The overt subjunctive marking doesn’t go along with a shifted interpretation of the world of evaluation of the matrix predicate; the corresponding interpretation is the same as in English.

(60) Ich wünschte / wollte, du wärest hier.

I wish.SUBJ / want.SUBJ you were here

There is additional evidence in support of the assumption that the overt subjunctive forms of German desire verbs in subjunctive mood are a reflex of their hidden counterfactual semantics. In German, subjunctive forms in conditionals can be expressed analytically with würden (‘would’) + infinitival. If we try to do this with the subjunctive forms of ‘wish’ and ‘want’, (61), we lose the unmarked interpretation and the sentences get a conditional interpretation in the sense of under such and such circumstances would I wish . . .

(61) Ich würde wünschen / wollen, du wärest hier.

I would want / wish you were here

20In all three cases (conditionals, good-predications and desire reports) the conditions of use can be traced back to an overt or hidden conditional operator.
8. Conclusion

In this paper I have argued that we can account for the similarities and differences between conditionals and good-predications if we assume that good-predications combine a standard semantics for conditionals with a standard semantics for the positive form of gradable adjectives and a minimal semantics for modal good that takes good to be a predicate of possible worlds.

References

Shared mechanism underlying unembedded and embedded enrichments: Evidence from enrichment priming
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Abstract. In this paper, we use a priming paradigm to explore the mechanisms underlying unembedded and embedded scalar enrichments. In particular, the aim is to see if local pragmatic enrichment could be a shared mechanism, involved in both. The two experiments presented adopt Bott & Chemla’s (2016) enrichment priming paradigm and test whether unembedded and embedded enrichments could prime each other. The goal is to investigate whether local pragmatic enrichment is indeed being accessed for the interpretation of the unembedded scalar and whether local enrichments, like other lexical semantic phenomena, are susceptible to priming.

Keywords: pragmatics, scalar enrichments, priming.

1. Introduction

Scalar implicatures are widely discussed as potentially Gricean conversational implicatures. (1-2) are examples of scalar implicatures, where what follows ‘→’ are implications that would follow in many easily imaginable situations:

1. Player A scored some of his shots.
   → Player A did not score all of his shots.
2. A: Alice was planning to cut the grass and wash the car. I wonder how she got on.
   B: She cut the grass.
   → Alice didn't wash the car.

Here we use ‘scalar implicature’ and ‘scalar enrichment’ as descriptive terms for the phenomenon where an implication arises which seems to involve the negation of a contextually salient alternative.

Many well-known proposals explain the implications in (1-2) broadly-speaking as Gricean conversational implicatures (see e.g. Gazdar, 1979; Geurts, 2010; Sauerland, 2004). On this kind of approach, an alternative for the assertion is inferred to be not true on the basis of reasoning about the speaker’s intentions. A widely discussed limitation of this approach is that it cannot explain certain so-called ‘embedded scalar enrichments’ (Chierchia, 2004; Chierchia, Fox, and Spector, 2012; Potts et al., 2016). An example of an embedded enrichment is given in (3) – taken from Potts et al. (2016):

3. Exactly one player hit some of his shots
   → Exactly one player hit some and not all of his shots

The observation is that it is unclear how a Gricean account of contextual implications can derive this effect, since the implication under (3) neither entails nor is entailed by what might have been literally asserted in (3). It seems rather that this effect is the product of an
enrichment of a sub-constituent of (3) (Chierchia, 2004) and it patterns together with other ‘local pragmatic effects’ that have been discussed virtually since Grice’s original theory was proposed (Cohen, 1971; Wilson, 1975; Carston, 1998).

Perhaps unlike any other kind of ‘local’ or ‘embedded’ pragmatic effect, embedded scalar enrichments have been quite intensively studied experimentally, with the aim largely being to establish the extent to which embedded scalar enrichments actually arise. Results have varied quite widely (Geurts and Pouscoulous, 2009; Chemla and Spector, 2011), and there has been some critical discussion of the methods used and the interpretation of results. However, a recent study reported in Potts et al. (2016) was designed to avoid many of the perceived methodological flaws of previous research, and found that participants quite regularly responded to a task based on an understanding of sentences like (3) as involving the implication indicated above.

1.1 Theoretical background

Two rather different approaches to embedded scalar phenomena have been outlined in the literature. According to the Grammatical Theory of Scalars (GT), the effects described in (1-2) and (3) are explained by the presence of a operator in the syntactic representation for the sentence. The only difference between the embedded scalar enrichment in (3) and the unembedded enrichments in (1-2) is the scope site at which the operator is inserted. This difference is illustrated in (4-5), where (4) is the LF for (1) and (5) is the LF for (3). Here $O$ is an operator whose interpretation relates that of its argument and the argument’s scalar alternatives in a manner akin to ‘only’ (see Chierchia et al., 2011 for details):

4. $[O \{\text{Player A}, [\text{t hit some of his shots}]\}]$
5. $[[\text{Exactly one player}], [O \{\text{t hit some of his shots}]\}]$

According to GT then, we can say that there is but one operation by which both unembedded and embedded scalar enrichments are derived.

Somewhat in contrast to GT, a variety of more-or-less Gricean approaches see at least some embedded scalar enrichments as the result of a separate process of local adjustment to the literal meaning of expressions. This approach takes a cue from the research tradition mentioned above in that it sees embedded scalar enrichments as a result of a general local enrichment mechanism that can result in a variety of different embedded effects, not just scalar enrichments (see Carston, 2002). According to this approach, it is conceptually possible that even unembedded scalar enrichments result from local enrichment. However, it is also allowed that unembedded scalar enrichments could be the result of general reasoning about the speaker’s intentions, along the lines of the well-known Gricean approach to scalars.

A recent articulation of this view is presented within the RSA framework (Frank and Goodman, 2012; Goodman and Frank, 2016). In that framework, it is possible to explain unembedded scalar implicatures in terms of general reasoning speakers and hearers may engage in about each other, making assumptions about how speakers would optimise the utility of their utterance by making the most specific assertion compatible with their
knowledge. In addition, as Bergen et al. (2016) observe, it is possible to incorporate the
apparent fact that local enrichments of an expression’s literal meanings are possible. Bergen
et al. set out a framework for computing an interpretation of an utterance given that
expressions may be interpreted using their literal meaning or one of a number of possible
enrichments. Thus a sentence such as (1), containing an unembedded ‘some’, may imply not all
because this can be inferred by ‘global’ reasoning about the speaker, as set out in the
standard RSA approach; alternatively, the implication may simply arise as an entailment of
the locally enriched interpretation of ‘some’. Bergen et al.’s RSA with lexical uncertainty
(RSA-LU) simply builds this fact into the reasoning that speaker and hearer engage in.
Likewise, when ‘some’ appears in an embedded context like (3), the framework simply takes
into account that there are several logically independent readings available.

Potts et al. (2016) show that models derived from RSA-LU better predict the results of an
experiment in which participants are asked to judge sentences like (3) against visual displays
that make the unenriched and locally enriched interpretation true. Potts et al. observe that
model performance can be closer or further from actual participants’ responses depending on
how the prior probabilities of local enrichments are adjusted. This point will be relevant to
our discussion of the results of our experiments below. For now, it is sufficient to observe
that RSA-LU is a framework for explaining embedded and unembedded scalar implicatures
(as in (1-3)) where a single operation (lexical enrichment) is active in both cases, but where
there is a second operation (global reasoning) in the unembedded case.

Thus, two approaches suggest that a common means exists for deriving unembedded and
embedded scalar enrichments. In this paper, we utilise the ‘enrichment priming’ paradigm of
Bott & Chemla (2016) as a means to determine experimentally whether, in fact, embedded
and unembedded scalar enrichments share a mechanism, or have a common operation.

1.2 Enrichment priming paradigm

Bott & Chemla (2016) developed an enrichment priming paradigm for the purpose of
obtaining empirical evidence for shared mechanisms within and across different categories of
unembedded scalar enrichments (i.e. quantifiers, numerals, ad hoc). In this task, each
sentence is presented with two pictures, and participants are asked to click on the picture that
is a better match for the given sentence. The critical items for a ‘within-category’ priming
condition are illustrated in Figure 1.

In this condition, the target and prime trials involve the same enrichment category. That is, a
target trial with ‘some’ is preceded by prime trials also with ‘some’; a target trial with
numerals is preceded by prime trials with numerals, etc. There are two types of prime trials,
Strong and Weak. Consider some → some in the top panel of Figure 1. In the Strong prime
condition, given the sentence Some of the symbols are clubs, the ‘strong’ image shows some
and not all symbols are clubs, and the other, ‘weak’ image shows all symbols are clubs. The
strong image makes the scalar-enriched interpretation (some and not all symbols are clubs)
true. The ‘weak’ image is only true on an unenriched interpretation of the target sentence.
Participants who choose the strong image prior to a target trial are thus primed by the SI-
enriched reading. In contrast, in the Weak prime condition, given the sentence Some of the
symbols are stars, one picture contains all stars and the other contains only non-stars. Neither picture makes the interpretation that includes the scalar implicature true. Participants who give a correct response in Weak prime trials have had to entertain the unenriched interpretation of the sentence prior to the target trial.

**Figure 1** *Example items in Bott & Chemla (2016)*

For the target trials, Bott & Chemla (2016) adopted the ‘Better-picture’ method used in Huang, Spelke & Snedeker (2013). Participants are shown one of two images while the other is covered. Participants are told that if they think that the covered picture would be a better match for the sentence, they can choose the covered picture. In this design, the visible image makes the unenriched reading true. Since the visible picture is inconsistent with the SI-enriched reading of the target sentence, choosing the covered picture indicates that participants access the SI-enriched reading.

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1 We have had permission from Dr Bott to use the figure from Bott & Chemla (2016).
In addition to within-category priming, the other condition is between-category priming, where the target and prime trials involve different enrichment categories. For instance, a target trial with number term (e.g. ‘four’) is preceded by prime trials with ‘some’. Bott & Chemla included all between-scale combinations in this condition, such as \( \text{some} \leftrightarrow \text{number} \), \( \text{some} \leftrightarrow \text{ad hoc} \), and \( \text{number} \leftrightarrow \text{ad hoc} \).

The logic behind this paradigm is that, if there is a shared derivation mechanism which is subject to priming, then for both conditions it is more likely for participants to access the enriched reading of the target sentence (i.e. choosing the covered picture) after strong prime trials than after weak prime trials. Their results show a within-category priming and a between-category priming effect. The within-category effect was stronger. There was also a surprising effect of within / between, such that more SI-based responses occurred in the between-category condition. We will return to discuss the latter result in Section 4. The main result of this kind of study, however, is that unembedded scalar enrichments can be primed by unembedded scalar enrichments.

Bott & Chemla (2016) interpreted the between-category priming effect as evidence for activation of shared mechanisms in deriving enrichments involving different scales. As for the within-category priming effect, they suggested that along with the activation of the derivation mechanism, there could also be a lexical priming effect, which is an association between the stimulus, the derivation mechanism and specific alternative. For Bott & Chemla, the between-category priming effect is most interesting result, because it shows that general SI derivation mechanism can be primed.

The general idea, then, is that an enrichment priming paradigm could be employed to investigate whether local pragmatic enrichment is a shared mechanism between unembedded and embedded scalar enrichments.

1. Experimental overview

The first goal of the experiments in this paper is to determine whether embedded and unembedded scalar phenomena have a shared mechanism. We investigate the mechanisms underlying unembedded scalar enrichment using the same paradigm as in Bott & Chemla (2016). The rationale is that, if unembedded scalar implicatures are derived using an operation or mechanism that is also involved in embedded scalar enrichments, then participants should be more likely to access embedded enrichments after strong primes with unembedded scalar implicature than after weak primes with no implicature. The critical items are illustrated in Figure 2.

In the embedded target condition, the target trial involving embedded ‘some’ is preceded by prime trials involving unembedded ‘some’. In strong primes, the unembedded scalar implicature is true, while in weak prime trials, the unembedded scalar implicature is false. For example, given a prime sentence ‘Some of the symbols are diamonds’, in strong primes, the sentence is presented with one picture depicting a row with some but not all symbols being diamonds and another picture depicting a row with all symbols being diamonds. The ‘some-not-all’ picture makes the SI-enriched reading true. For the weak primes, the same sentence is presented with one picture in which all symbols in the row are diamonds and one
picture depicting a row of non-diamond symbols. Neither picture makes the SI-enriched reading true. Thus, participants are primed by the SI-enriched reading in strong primes and the unenriched reading in weak primes.

![Diagram](image.png)

**Figure 2 Critical items for embedded target condition in Experiment 1 and 2**

As in Chemla & Bott, we employ the covered picture paradigm in the target trials. We have experimental trials in which a sentence with an embedded scalar term is the target. We also include a set of trials where an unembedded sentence is the target, following embedded prime trials. For target trials in the embedded target condition, a target sentence like ‘On exactly one row, some of the symbols are squares’ is presented with a visible picture and a covered picture. The visible picture makes the locally enriched reading true and other available readings false. The image in Figure 2 shows the visible image having two rows containing squares. One of those has some and not all squares, the other has all squares. Only if the sentence is understood as On exactly one row, some and not all of the symbols are squares would a participant not choose the covered card. If the literal meaning of the target sentence is accessed, or even an interpretation that includes a global implicature, the participant should choose the covered card.

This is a change from Bott & Chemla’s procedure. As previously mentioned, the visible picture used in Bott & Chemla’s paradigm makes the literal reading true and SI-enriched reading false. The motivation for changing their design comes from the availability of the global-SI reading. The global-SI reading of the target sentence is that on exactly one row, some symbols are squares and it’s not true that on exactly one row, all symbols are squares. If the target sentence is presented with a visible picture that makes the literal reading true, as shown in Figure 3 (left), then participants might choose the covered picture because they derive a reading of the sentence that includes a global SI and expected a better match, such as Figure 3 (right). If this is the case, then choosing the covered picture in Figure 3 might reflect a mixture of local reading and global reading.

![Diagram](image.png)

**Figure 3 Alternative displays.** The target (left image) consists of one picture that makes the literal reading true and the ‘Better Picture?’ option. The right image makes the global-SI reading of ‘On exactly one row, some of the symbols are squares’ true.
Thus, in order to properly measure the rate of locally enriched reading, in both Experiments 1 and 2 below, the embedded target sentence is paired with a visible picture for which the sentence is false on any available reading except for the local one. In this case, choosing the visible picture indicates that participants access the locally enriched reading, whereas choosing the covered picture indicates that they access either the literal reading or the global reading.

Regarding whether unembedded enrichments could prime embedded enrichments, the grammatical account predicts a priming effect, as there is a single mechanism for both prime and target trials involving $O$ operator in LF. On the other hand, the RSA-LU approach predicts priming between the two based on the mechanism of lexical adjustment, which can be used in both prime and target trials. However, RSA-LU does not rule out the possibility that there is no priming effect. This is so since there are two mechanisms underlying scalar enrichments, rather than a single one. It is possible that the lexical adjustment mechanism is not used very much in prime trials. If this is the case, then there might not be a priming effect between unembedded and embedded enrichments.

In addition to the embedded target condition, both experiments also included an unembedded target condition. In the unembedded target condition, the target trial involving unembedded ‘some’ is preceded by prime trials involving embedded ‘some’. Experiment 1 and 2 differ in the prime items used in unembedded target condition, which will be discussed in more detail below. Regarding whether embedded enrichments could prime unembedded scalar implicature, the grammatical account again predicts a priming effect on the basis of a single shared mechanism. The RSA-LU also predicts a priming effect, as the lexical adjustment mechanism is needed for embedded prime trials (especially in Experiment 2), and the target trial can be enriched in the same way.

2. Experiment 1

3.1. Overview and prediction

In prime trials, participants were presented with a sentence paired with two pictures. Their task was to click on the picture that makes the sentence true. The sentences contained a scalar term ‘some’, which could occur in either unembedded or embedded position. Three types of pictures were available for each sentence: (i) false pictures, which make all possible readings false, (ii) weak pictures, which make the literal reading true but the enriched reading false, and (iii) strong pictures, which make enriched readings true. As will become clear below, the design of this study differs a little from Bott & Chemla. In their paper, strong pictures make not only the enriched meaning true but also the literal meaning. This is also the case in our unembedded prime and target trials, as well as the embedded prime trials in Experiment 1. However, it is not the case for the embedded target trials in either Experiment 1 or Experiment 2, for the reason discussed above (in relation to Figures 2 & 3). As mentioned above, in order to avoid responses that were not solely based on a genuine local enrichment operation, we had to make the verifying scenario for the embedded target sentence falsify the literal meaning.
Two types of priming effects were examined: unembedded prime → embedded target, as shown in Figure 2, and embedded prime → unembedded target, as shown in Figure 4 below.

There were two types of prime trials. Participants were primed by the literal reading in weak primes and the enriched reading in strong primes. Following the procedure in Bott & Chemla (2016) and Raffray & Pickering (2010), each target trial was preceded by two prime trials, in order for the priming effect to be given a better chance of having an effect. For target trials, the sentence was presented with an open picture and a covered picture. Participants were instructed to click on the covered picture (‘Better Picture?’) if they thought there was a picture that would be a better match for the given sentence.

![Diagram](image)

**Figure 4 Critical items for unembedded target condition in Experiment 1**

The embedded target condition has been discussed in detail in the previous section. Here we focus on the unembedded target condition. The critical items of this condition are illustrated in Figure 4. In the unembedded target condition, the target trial involving unembedded ‘some’ was preceded by prime trials involving embedded ‘some’. For embedded prime trials, given the prime sentence like ‘On each row, some of the symbols are ticks’, in strong primes, the sentence was presented with a weak picture depicting all symbols being ticks and a strong picture depicting rows of symbols with some but not all being ticks. The strong picture made the locally enriched reading of the sentence true (i.e. *On each row, some but not all of the symbols are ticks*). For the same sentence, in weak primes, it was presented with a weak picture and a false picture depicting all symbols being non-ticks. Neither picture made the local reading true. Participants were thus forced to access the literal reading in weak primes.

Note that the sentences used for embedded target trials like ‘on exactly one row, some of the symbols are squares’ were not used in embedded prime trials. This is because when ‘some’ is embedded under a non-monotonic quantifier, the literal reading and local enriched reading are logically independent. Thus, if non-monotonic cases are used as embedded primes, there is no better picture (in the sense of entailment) between a picture that makes the literal reading true and a picture that makes the enriched reading true.

As for unembedded target trials, the target sentence was the same as the one used for unembedded prime trials. Unlike embedded target trials, here the unembedded target sentence
was presented with a visible picture that made the literal reading true. In this case, choosing the visible picture indicates that participants access the literal reading, whereas choosing the covered picture indicates that they access the SI-enriched reading.

In general, both the GT and the RSA-LU approach predict priming effects between unembedded and embedded enrichments, since both approaches assume there is a shared mechanism between unembedded and embedded enrichments. Overall, the rate of enriched-reading responses to target trials should be higher after strong primes than after weak primes. However, as mentioned above, there is a subtle difference between the two approaches in terms of the potential strength of priming in the different target conditions. The GT says that there is only one mechanism of exhaustification and it is present in both unembedded and embedded scalar enrichments. Thus, whether unembedded trials or embedded trials are primes, the subsequent target should receive more enriched responses after strong prime trials. For the RSA-LU approach, this prediction holds for the embedded prime → unembedded target trials. However, for the case where the prime is unembedded, there are two routes to an enriched response. Only if enriched responses in unembedded primes involve a local pragmatic enrichment should there be substantial priming in the embedded target conditions. We shall return to this difference below.

3.2. Method

3.2.1. Participants

20 participants were recruited via Prolific Academic (http://prolific.ac). All participants were native English speakers.

3.2.2. Materials

This experiment had a two-by-two within-participant design. The two independent variables were the embeddedness of the target and the type of the prime. These two variables generated four prime-target combinations, as shown in Table 1. Sixteen experimental prime-target triplets were constructed. In each triplet, one target trial was preceded by two prime trials. Each trial consisted of a single sentence and two pictures. Eight triplets formed the unembedded prime → embedded target trials, the other eight formed the embedded prime → unembedded target trials. In half of the unembedded prime → embedded target trials, the target was preceded by two weak primes, while in the other half, the target was preceded by two strong primes. This was the same for the embedded prime → unembedded target trials.

<table>
<thead>
<tr>
<th>Target embeddedness</th>
<th>Prime type</th>
<th>Number of sets</th>
<th>Number of trials</th>
<th>Number of trials</th>
</tr>
</thead>
<tbody>
<tr>
<td>embedded target</td>
<td>weak</td>
<td>4</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>strong</td>
<td>4</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>unembedded target</td>
<td>weak</td>
<td>4</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td>strong</td>
<td>4</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>48</td>
<td></td>
</tr>
</tbody>
</table>
Table 1  Design of experimental items in Experiment 1

For unembedded prime and unembedded target trials, the sentence was of the form *Some of the symbols are [symbol]*. For embedded prime trials, the prime sentence was of the form *On each row, some of the symbols are [symbol]*, whereas for embedded target trials, the target sentence was of the form *On exactly one row, some of the symbols are [symbol]*. The symbols came from the set of circles, crosses, diamonds, hearts, squares, stars, ticks, and triangles.

48 filler trials were constructed. As with experimental trials, each consisted of a single sentence and two pictures. The sentence either contained ‘some’ as in *Some of the symbols are [symbol]* or *On each row, some of the symbols are [symbol]*, or contained ‘all’ as in *All of the symbols are [symbol]* or *On each row, all of the symbols are [symbol]*. Following the design in Bott & Chemla (2016), each type of filler sentences occurred in three situations: (i) the sentence was presented with a strong picture and a ‘Better Picture?’ (ii) the sentence was presented with a false picture and a ‘Better Picture?’; and (iii) the sentence was presented with a false picture and a strong picture. (i) and (ii) were included to counterbalance the times when, in the target trials, the covered picture (‘Better Picture?’) was always paired with the weak picture. These trials also counterbalanced the extra times when in prime trials the sentence was always paired with two visible pictures. (iii) was included so that all possible pair combinations of three picture types (false, weak, strong) occurred equally frequently.

In total, Experiment 1 contained 48 experimental trials (i.e. 16 prime-target triplets) and 48 fillers. The triplets of trials and the fillers were presented in a randomized order created for each participant. For prime trials, the position of the correct choice was counterbalanced across trials, so that for half of the trials the correct choice was on the left, and for the other half on the right. Furthermore, for half the experimental triplets the correct choice was on the same side for the first and the second prime, while for the other half it was on the opposite side. For target trials, the covered picture was always on the right. In addition, in one dual prime-target triplet, a different symbol was used as the predicate for each sentence. There were 8 symbol types. Each was used as the predicate an equal number of times.

3.2.3. Procedure

Participants were instructed to click on the picture that made the sentence true. On occasions where one of the two pictures were covered, the task was the same. But participants were told that “if you think that there is a picture that would be a better match for the sentence, click on the ‘Better Picture?’ option”. Two examples were given. One involved ‘many’, in which the sentence ‘There are many stars’ was presented with one picture containing six stars and the other containing two. Participants were told to click on the picture containing six stars. The other example involved an ad hoc enrichment, in which the sentence ‘There is a spade’ was presented with one covered picture and one picture containing a spade and a diamond. In this case, participants were instructed to click on the ‘Better Picture?’ option.

---

2 For weak primes, the correct response was the weak picture. For strong primes, although both pictures made the sentence true, we coded the strong picture as the correct response.
There were four practice trials to familiarise participants with the task. In these trials, the sentence was either presented with a false picture and a strong picture or with a false picture and a covered picture. No feedback was given in either practice or experimental trials. The whole experiment lasted approximately 10 minutes.

3.2.4. Data treatment and analysis

The analysis was performed on the responses to target trials. Only target responses that were preceded by two correct prime responses were included in the analysis. This resulting in the removal of 35 out of 320 target responses. Of the 35, 19 were embedded targets and 16 were non-embedded targets. For the remaining target responses, we coded the enriched response as 1 and the unenriched response as 0. Note that the enriched response for embedded target trials was choosing the visible picture, whereas the enriched response for unembedded target trials was choosing the covered picture.

We fitted a logistic mixed-effect model to predict the log odds of choosing an enriched over unenriched response from fixed effects of embeddedness (embedded targets / non-embedded targets) and prime type (weak / strong). Embeddedness and prime type were deviation coded (embedded = 0.5, non-embedded = -0.5; strong = 0.5, weak = -0.5). The model contained maximal random effects structure supported by the data, which included random intercepts and slopes for subjects and random intercepts only for items. All fixed effects and their interactions were included as random slopes. Statistical analyses were carried out using R (version 3.3.3, R Core Team, 2017) with the lme4 package (Bates et al. 2015) and the lmerTest package (Kuznetsova, Brockhoff, and Christensen 2014).

3.3. Results and discussion

![Proportion of enriched responses across conditions](image)

**Figure 5** The proportions of enriched responses across conditions in Experiment 1

Figure 5 shows the proportions of enriched responses across conditions. We found a main effect of priming ($\beta = 1.84$, SE = 0.62, $p = .003$). However, planned comparisons on each level of prime type showed that the rate of enriched responses was significantly higher after strong primes than after weak primes only in unembedded target conditions ($\beta = 3.48$, SE = 1.36, $p = .01$) but not in embedded target conditions ($\beta = 4.55$, SE = 3.87, $p = .24$). Thus, the observed priming effect was mainly driven by the priming in the unembedded target conditions.
condition. There was a main effect of embeddedness ($\beta = 4.81, SE = 1.22, p < .001$), suggesting that the overall rate of enriched responses was higher for embedded target trials than for unembedded target trials. The interaction between embeddedness and prime type was not significant ($\beta = -2, SE = 1.42, p = .16$).

The main effect of embeddedness in the present study is inconsistent with findings from previous research that demonstrate unembedded scalar enrichments are more robust than embedded cases (e.g. Benz & Gotzner, 2014; Geurts & Pouscoulous, 2009). However, it is difficult to read too much into this result, since the enriched response in the embedded target condition is the open card, while the enriched response in the unembedded target condition is the covered card.

Regarding whether unembedded enrichments could prime embedded enrichments, the results of this experiment are difficult to interpret. On the one hand, there is a main effect of prime type and we found no significant interaction. On the other hand, we failed to find a significant difference between Strong and Weak conditions in the embedded target condition. The main effect was driven by the significant difference between Strong and Weak trials in the unembedded target condition. This latter result is supportive of the idea that there is a shared mechanism between unembedded and embedded scalar enrichments. However, an alternative explanation for this priming effect could be given without appealing to local enrichment. Consider the items in Figure 4 again. As long as participants access the reading *On each row some of the symbols are ticks and it is not the case on each row all of the symbols are ticks*, they would choose the strong picture. This means that local enrichment is not required in deriving this reading. Enriched responses in embedded primes could be the result of global inference mechanism. Then what seems to be a local $\rightarrow$ local priming would turn out to be a global $\rightarrow$ global priming. Thus, the priming effect in unembedded target condition cannot be taken as conclusive evidence for a shared mechanism in deriving unembedded and embedded enrichment.

4. Experiment 2

In order to properly explore whether embedded and unembedded enrichments could prime each other, we conducted Experiment 2, which addressed the problems of interpreting the results of Experiment 1.

4.1. Method

4.1.1. Participants

30 participants were recruited via Prolific Academic (http://prolific.ac). All participants were native English speakers.

4.1.2. Materials, procedure

The materials were similar to Experiment 1 with one key difference, namely that for the embedded prime trials, the prime sentence was of the form *On exactly one row, some of the*
symbols are [symbol]. As illustrated in Figure 6, in strong primes, the sentence was presented with a picture that made the literal reading true and a picture that made only the local reading true. If the participants access the local enriched reading, On exactly one row, some but not all of the symbols are ticks, then the only picture that made the sentence true is the ‘local’ picture. Since embedded enrichments in the non-monotonic environment can only be explained by local enrichment, in Experiment 2, participants who choose ‘local’ picture in embedded prime trials must access local enrichment.

<table>
<thead>
<tr>
<th>Prime</th>
<th>Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>weak</td>
<td>Some of the symbols are diamonds</td>
</tr>
<tr>
<td>On exactly one row, some of the symbols are ticks.</td>
<td></td>
</tr>
<tr>
<td><img src="image.png" alt="Diagram" /></td>
<td><img src="image2.png" alt="Diagram" /></td>
</tr>
</tbody>
</table>

Figure 6 Critical items for unembedded target condition in experiment 2

As with Experiment 1, 48 filler trials were constructed. The filler sentence was of the form All of the symbols are [symbol] or On exactly one row, all of the symbols are [symbol]. Like in Experiment 1, each type of filler sentence occurred in three situations: (i) the sentence was presented with a strong picture and a ‘Better Picture?’; (ii) the sentence was presented with a false picture and a ‘Better Picture?’; and (iii) the sentence was presented with a false picture and a strong picture. All the other materials and the procedure were the same as Experiment 1.

4.1.3. Data treatment and analysis

As in Experiment 1, the analysis was performed on target responses that were preceded by two correct prime responses. This resulting in the removal of 84 out of 480 target responses. Of the 84, 24 were embedded targets and 60 were non-embedded targets. For the remaining target responses, we coded the enriched response as 1 and the unenriched response as 0.

Again we fitted a logistic mixed-effect model to predict the log odds of choosing an enriched over unenriched response from fixed effects of embeddedness (embedded / non-embedded) and prime type (weak / strong). The model contained random intercepts and slopes for subjects and random intercepts only for items. All fixed effects were included as random slopes.

4.2. Results and discussion
Figure 7 shows the proportions of enriched responses across conditions. There was a main effect of priming ($\beta = 1.33$, SE = 0.39, $p < .001$). Again, planned comparisons on each level of prime type showed that the rate of enriched responses was significantly higher after strong primes than after weak primes only in unembedded target conditions ($\beta = 1.56$, SE = 0.54, $p = .004$) and not in embedded target conditions ($\beta = -1$, SE = 1.71, $p = .56$). There was no main effect of embeddedness ($\beta = 2.07$, SE = 1.23, $p = .07$), and the interaction between embeddedness and prime type was not significant ($\beta = -0.75$, SE = 0.77, $p = .33$).

In this experiment, enriched responses in both embedded prime and embedded target trials could not be the product of a global enrichment. Thus, the main effect of prime types provides clear evidence that embedded and unembedded scalar implicature share a mechanism. In particular, the priming of the enriched response in the unembedded target by the embedded prime provides somewhat more direct evidence that unembedded scalar enrichments can be derived by the mechanism for local enrichment.

Overall, the main effect of prime provides support to both GT and RSA-LU accounts. In terms of discriminating between the two approaches, once again, the results are difficult to interpret, although suggestive. On the one hand, we found a priming effect in the unembedded target condition but not the embedded target condition; on the other hand, the interaction did not reach significance. It is also worth noting that the items in the embedded target condition were identical across both experiments and in both cases no effect was found in either case. As mentioned above, the RSA-LU approach predicts that, if there were an asymmetry in the priming effect, it would occur in the direction found. This is because, while embedded prime trials involve mandatory enrichment, unembedded prime trials do not. Thus the RSA approach suggests a stronger priming effect in the unembedded target condition.

5. Inverse Preference and Frequency of Local Enrichment

In this section, we will relate the results of Experiment 2 to the so-called ‘Inverse Preference Effect’. Inverse preference is the phenomenon whereby a less frequent parse of a word or structure gives rise to a larger priming effect than more frequent parses (Hartsuiker, Kolk, and Huiskamp, 1999; Hartsuiker and Westenberg, 2000; Hartsuiker and Kolk, 1998;
Scheepers, 2003). For example, studies that manipulate active and passive syntactic structures find that passives, which are the less frequent construction, give rise to larger priming effects than actives (Bock, 1986). Currently favoured explanations of this effect revolve around the idea that priming itself is a result of implicit learning (Pickering and Ferreira, 2008) and that inverse preference results from error correction (Jaeger and Snider, 2013).

Inverse preference is relevant to the results in Bott & Chemla (2016), because it potentially helps to explain a surprising result in their main experiment. This is the fact that Bott & Chemla found a main effect of Within / Between, such that there were more enriched responses in the Between condition than Within, even though there was a significantly bigger effect of prime in the Within condition. This can be explained in terms of inverse preference if it is assumed that the unenriched response in prime trials is the less frequent or somehow unexpected one. This means that for Weak prime trials, there is a large priming effect for the unenriched response, causing participants to select the open picture in target trials. Bott & Chemla observe that the large priming effect in Within trials is indeed mostly due to a below baseline response in Weak trials. That is, compared to a condition where the prime was unrelated to the target in terms of scalar implicature, participants made fewer enriched responses in the Weak prime condition.

Let us now turn back to the results of Experiment 2 to consider where there might be an inverse preference effect. When we consider the unembedded target condition, it could be that because unenriched ‘some’ in Weak prime trials is unexpected, this primes the unenriched interpretation in the target. However, if the priming effect in unembedded target trials is because of below-baseline rates in weak trials, this would not explain why a similar effect is not obtained in the embedded target condition. Of course, it could be that, again, we simply failed to find the same below-baseline effect in this condition. Alternatively, if there are two mechanisms involved in scalar implicature, the literal interpretation of ‘some’ may be intermediate in its expectedness between a more frequent globally enriched reading and a less frequent locally enriched reading. This would explain the large priming effect in unembedded target trials, because the Strong primes in this condition require local enrichment and, by hypothesis, local enrichment is a less frequent response than no enrichment.

When it comes to the Embedded target condition, if global enrichment is more often used to respond to strong unembedded prime trials than local enrichment, and literal unenriched meanings are used in weak trials, then we should not expect to see such a great priming effect, because the target trials require local enrichment. This would mean that, although both global and local processes may be responsible for unembedded scalar enrichments, the global process may be the more common route.

At present, we have too little data to discriminate among these possibilities. Further studies would be required to shed light on the relation between global and local scalar enrichments in terms of their frequency. At a minimum, we would need to include an unrelated control condition here to get a better baseline.

6. Conclusion
The primary aim for this paper was to use the enrichment priming paradigm to determine whether embedded scalar enrichments and unembedded scalar enrichments involve a shared mechanism. In two experiments, we found evidence supporting a shared mechanism. In particular, Experiment 2 showed clearly that embedded prime trials, where local enrichments are mandated, lead to more unembedded scalar enrichments in targets than when only the literal meaning of ‘some’ is used in primes. This latter result in particular highlights that activation of locally enriched meanings of ‘some’ can impact on rates of unembedded scalar enrichments.

Although there are relevant differences between the RSA-LU and GT, the data in this paper does not conclusively favour one or the other. However, a twice-replicated lack of effect in the embedded target condition fits better with the Gricean picture than the Grammatical one. Again, more studies would be needed to pursue this matter further. For instance, a similar kind of study that mixes lexical triggers in an unembedded target condition might provide such a test. We leave this question open for future research.

Finally, a speculative discussion about whether the results reported in Experiment 2 might be the result of an inverse preference effect led to the suggestion that perhaps the locally enriched interpretation of ‘some’ is less frequent or more surprising than either the globally enriched or literal interpretation.

References


Mouton de Gruyter.
Generics and typicality
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Abstract. Cimpian et al. (2010) observed that we accept generic statements of the form ‘Gs are f’ on relatively weak evidence, but that if we are unfamiliar with group G and we learn a generic statement about it, we still interpret it in a much stronger way: (almost) all Gs are f. This paper makes use of notions like ‘representativeness’ and ‘contingency’ from (associative learning) psychology to provide a semantics of generics that explains why people accept generics based on weak evidence. We make use of the Heuristics and Biases approach of Tversky and Kahneman (1974) and the Associative Theory of Probability Judgements to explain pragmatically why people interpret generic statements in a much stronger way. The spirit of the approach has much in common with Leslie’s (2008) cognition-based ideas about generics, but the semantics is grounded on Cohen’s (1999) relative readings of generic sentences. The basic intuition is that a generic of the form ‘Gs are f’ is true, not because most Gs are (or tend to have) f, but because f is typical for G, which means that f is valuably associated with G.

Keywords: generics, association, probabilities, pragmatics.

1 Introduction

Although generics are studied mostly in formal semantics and philosophy, they have recently attracted the attention of cognitive psychologists as well. The reason is that generics play a core role in the way we learn, represent and reason about groups in the world (cf. Leslie (2008)). Indeed, generic statements express very basic kinds of inductive generalizations, learned during the process of categorization. A central hypothesis of this paper is that the way we learn new categories is, and remains, of crucial importance for judgements involving those categories. I will argue that generic statements about categories, or groups, express typical information about these groups, and that the way we learn about a group is of crucial importance for what is typical about this group. The notion of contingency from associative learning psychology plays an important role in learning, and I will argue that a slight generalization of it is crucial for typicality as well, and thus for the analysis of generics.

After providing a biased overview of some semantic theories of generics (concentrating in particular on Cohen’s proposal) in section 2 and theories of categorization in section 3, I will discuss my own semantic account of generics in section 4. This semantic analysis will give rather weak truth conditions to generic sentences. After that we will provide in section 5

2 Some Semantic Theories of Generics

Generic sentences are sentences that, by their very nature, express useful generalizations. The main question addressed in the literature is about the type of generalization. First, generic sentences are clearly not universally quantified sentences: although not all birds fly (penguins don’t), (1) is a good generic sentence that most people consider true.

(1) Birds fly.

Indeed, this is one of the most typical features of generic sentences: they express generalizations that allow for exceptions. But it also need not be the case that almost all, or most Gs have feature f in order for the generic ‘Gs are f’ to be true:

(2) Birds lay eggs.

Although (2) is true, it is not the case that the majority of birds lay eggs; only the adult female birds do! Moreover, even if most Gs are (or are taken to be) f, the corresponding generic sentence still doesn’t have to be true, as exemplified by sentences such as the following:

(3) Germans are right handed.

Finally, such an analysis is extensional, and that is taken to give rise to problems exemplified by the following, much discussed, generic (4):

(4) Mail from Antartica is handled by Tanja.

This generic can be true, even though we’ve never gotten any mail from Antartica. It is normally argued that what such an example points to is a demand for an intensional treatment of generics. Arguably, however, (4) is a normative generic, and normative generics cannot be given a purely extensional treatment anyway. But, of course, there is a much better reason why generics should not depend on certain actually observed extensionally given sets: if our theory claimed this, we could not account for their inductive, or unbounded, character.

According to the modal nonmonotonic approach of Asher and Morreau (1995), Pelletier and Asher (1997) and others, ‘Gs are f’ is true if and only if for any entity d and all worlds in which d is a normal G, d has feature f. Such theories want to account for a type of default instantiation, that is, for the fact that if all we know is that the sentences ‘Gs are f’ and ‘x is a G’ are true, we can normally, or by default, conclude by instantiation that x has feature f. Proponents of nonmonotonic logic typically argue that what is normal need not have anything
to do with proportions. But without a independent characterization of what normal is, such a
theory is not very predictive (Krifka et al., 1995; Pearl, 1988).\(^2\) Moreover, whatever ‘normal-
ity’ is taken to mean, any analysis that wants to account for ‘default instantiation’ will have
problems accounting for the intuition that the following generics are both true.

(5) a. Ducks lay eggs.
   b. Ducks have colourful feathers.

In order to predict that (5a) is true, it must be the female ducks that should be relevant or
normal, while it is the opposite sex that is relevant or normal for (5b).

There is another typical kind of example that is problematic for the analyses discussed so far.
Consider the following (seemingly true) generics:

(6) a. Ticks carry the Lyme disease.
   b. Sharks attack people.

Sentences (6a)-(6b) are examples of what Leslie (2008) calls ‘striking generics’. A generic
sentence is striking if only very few of the \(G\)s need to have feature \(f\) for the generic sentence
‘\(G\)s are \(f\)’ to be true. According to Leslie, striking often means ‘horrific or appalling’. However,
the truth conditions suggested above also seem to hold for familiar examples like (7a)-(7b) that
are intuitively not ‘horrific’.

   b. Dutchmen are good sailors.

Intuitively, a sentence like (7a) is true not because most Frenchmen eat horse meat, but because
relatively many Frenchmen do so. These types of examples motivated Cohen (1999) to claim
that generic sentences are in fact ambiguous. They can both have an absolute and a relative
reading. On the absolute reading, ‘\(G\)s are \(f\)’ is true iff most \(G\)s are \(f\), while on the relative read-
ing it is true iff relatively more \(G\)s are \(f\), than \(\neg G\)s are, where \(\neg G\)s are the relevant alternatives
to \(G\). Cohen proposes that generic sentences are standardly interpreted in the absolute way, but
that sentences that are problematic for many other treatments of generics like (7a)-(7b) should
be interpreted in the relative way, just as examples like (5a) ‘Ducks lay eggs’ and ‘Lions have
manes’. Presumably, the same is the case for the striking generics (6a)-(6b).

Where Cohen (1999) gives two separate treatments of absolute and relative generics, in Cohen
(2001) he provides yet another analysis of non-descriptive generics like the following:

(8) a. Bishops move diagonally.
   b. The Speaker of the House succeeds the Vice-President.

\(^2\)Of course, this is reminiscent of a similar criticism one might give to semantics of counterfactuals that make
crucial use of a primitive notion of ‘similarity’.

Generics and typicality 445
Cohen (2001) assumes that non-descriptive generics have an underlying logical form that differs radically from their surface form, and that they also have a very different interpretation.

Although I undoubtedly take Cohen’s analysis to be a major step forward compared to other analyses of generics, it is certainly not without problems. The first problem for Cohen’s analysis I take to be the claimed ambiguity. Can it really be the case that there is no common core between all types of generics? Should absolute generics really be given a separate treatment from relative and non-descriptive ones? The proposal, for instance, that non-descriptive generics have an underlying logical form that differs radically from their surface form, and that they also have a very different interpretation from descriptive generics is prime facie, at least, problematic. It would be more natural, intuitively, to give all types of generics the same logical form, and have an interpretation of generics that works similarly for them all.

A related problem is noted by Leslie et al. (2011), who observe that Cohen’s analysis of relative generics predicts that an example like (9) comes out true.

(9) Dogs have three legs.

Example (9) is clearly predicted to be false on its absolute reading. It is predicted to be true on the relative reading, however. The reason is that dogs have a higher probability of staying alive after losing a limb than wolves, foxes, hyenas, et cetera, because three-legged dogs will be taken care of by their owners. Furthermore, dogs seem to have a higher probability of losing a limb then say hamsters, rabbits, miniature donkeys, and parakeets. Hence, the generic (9) is true relative to both the alternative set Pets and the alternative set Dog-like animals.

Of course, Cohen could simply claim that (9) only has an absolute reading, and on that reading the sentence is correctly predicted to be false. But this move only brings us back to the first problem: how should we determine which reading each generic sentence should have?

What (9) also illustrates is that Cohen’s analysis of relative readings is too weak. This is not only the case empirically, but also conceptually: they seem to be too weak to be of any use.

Although various aspects of Cohen’s analysis of generics have come under attack, in this paper I will build on Cohen’s analysis, in particular on his relative readings. Let me here already point to one, I feel, under-appreciated aspect of such readings. Consider generic sentences that express comparative relations, like (10):

(10) Boys are taller than girls.

Although other analyses of generics might be able to account for such readings as well, an analysis in terms of relative readings is almost immediate. The reason is that relative readings are (perhaps implicitly) already treated as comparatives! Let us assume, just for simplicity, an analysis of comparatives as given in Klein (1980): ‘John is taller than Sue’ is true iff there is a comparison class including (perhaps only) John and Sue such that John is tall with respect to this comparison class, while Sue is not. Similarly, (10) will be true if there is a comparison
class $c$ including (perhaps only) boys and the girls such that with respect to this comparison class boys are tall and girls are not. Notice that according to the relative reading of the generic sentence ‘Boys are tall’, the sentence is true iff $P(\text{tall}(c)/\text{boys}) > P(\text{tall}(c)/\neg\text{boys})$. If $c$ consists of only the boys and girls this reduces to $P(\text{tall}(c)/\text{boys}) > P(\text{tall}(c)/\text{girls})$. Similarly, the generic sentence ‘Girls are not tall’ is true on its relative reading in this context iff $P(\neg\text{tall}(c)/\text{girls}) > P(\neg\text{tall}(c)/\text{boys})$, i.e., iff $1 - P(\text{tall}(c)/\text{girls}) > 1 - P(\text{tall}(c)/\text{boys})$ iff $P(\text{tall}(c)/\text{girls}) < P(\text{tall}(c)/\text{boys})$. As a result, sentence (10) is predicted to be true iff $P(\text{tall}(c)/\text{boys}) > P(\text{tall}(c)/\text{girls})$, which indeed seems to be the correct result.

Leslie (2008) observes that although generics are extremely hard to analyse truth-conditionally, we are able to understand and use them successfully with relative ease. She suggests that this is so because generics are the expression of a very primitive default mode of generalizing, which picks up on significant or striking properties and links them to psychologically salient kinds. I completely agree with her cognitive approach, and that the analysis of generics should be closely tied to the way we categorize and make inductive generalizations. I would like to focus on this insight as well. As we will see though, this doesn’t necessarily mean that truth-conditional approaches like those of Cohen (1999) are wrong headed. Moreover, or so I will argue, this doesn’t mean that generics are as (at least 5-way) ambiguous as Leslie et al. (2011) suggest. Perhaps it is possible to give a more uniform semantic analysis of all types of generic sentences, once we know more about typicality and how we learn inductive generalizations.

3 Typicality and associative learning

People have the natural tendency to classify the objects around them in terms of categories. Objects are grouped together to form a category if they have characteristics in common or are roughly similar to one another. Our thinking in terms of categories reduces the complexity of the world around us considerably. Categorization is one of the most common and most important things we do all the time and crucially influences our behavior. One of the most important functions of categories is that they allow us to make use of induction and generalization. Indeed, the process of categorization itself is perhaps the most basic type of generalization we make. It is only natural to assume with Leslie (2008) that generic sentences about categories express these basic generalizations. This suggests that to figure out why we accept certain generic sentences but not others, it is crucial to understand this basic process of categorization.

One of the main claims of this paper is that a generic of the form ‘Gs are $f$’ is true if $f$ is a typical feature of Gs, or if typical members of the category G have feature $f$. Typicality is well-studied in cognitive psychology. According to prototype theory, groups (or categories) are represented by typical members, rather than by all of them and only them, or by typical features, rather than by necessary and sufficient features, because agents have limited attention and limited recall of examples. But what are a group’s typical members or features? According to Rosch (1973), it is the central, or average members of the group, or the features most members have. Centrality is determined in terms of a notion of similarity. Barsalou (1985) experimentally showed on the basis of a thorough correlational analysis, however, that at least
for goal-derived artificial categories, the typical members are instead the category’s ideal members; those that best satisfy the goal. For example, the ideal of the category ‘things to eat on a diet’ presumably is ‘zero calories,’ which clearly is not a common, but rather an extreme value for members of the category. Idealness can be defined as the extent to which a certain object displays a quality that is directly related to the goal. More recent empirical findings (Ameel and Storms, 2006; Burnett et al., 2005) show that extreme members of a group are also considered typical for many, if not most, other types of categories, namely if categorization is performed in a contrastive way. Typical members of a category have features that distinguish them from members of other categories; as such, they highlight, but also exaggerate, real differences between groups.

Typical features for a group are taken to be features that are representative for the group. This is important for our analysis of generics. Furthermore, I claim that the way we learn categories is, and remains, of crucial importance for judgements involving those categories.

A popular way to approach the learning of categories involves associative learning based on frequencies and correlations. Much of that psychological research was done before the cognitive revolution in psychology, in classical conditioning. In classical conditioning, what is learned is an association between a cue and an outcome. The cue, $C$, such as the sound of a bell, or a tuning fork, can become associated with an outcome, $O$, which can be thought of either as something like the taste of food, or a shock, or an unlearned reflex response to that, like salivation, or high blood pressure indicating fear. Pavlov hypothesized that the strength of association between cue and outcome depends on the number of times the two are paired.

Subsequent research has revealed, however, that for prediction it is not exactly the number of pairings between cue and outcome that is crucial. In a classic study, Rescorla (1968) showed that rats learn a tone ($C$) $\rightarrow$ shock ($O$) association if the frequency of shocks immediately after the tone is higher than the frequency of shocks undergone otherwise. Within associative learning psychology, this difference in frequency is known as the contingency of the shock on the tone. The central finding of Rescorla (1968) was that the higher the contingency of shock on the occurrence of the tone, the more the rats anticipated the fear of a shock. Thus, the higher the contingency, the more useful the tone is as a predictor of the shock. Of crucial importance for our paper is that these experiments show that rats will develop a tone $\rightarrow$ shock association even if shocks occur only in, say, 12% of the trials in which a tone is present, as long as the frequency of the shocks experienced otherwise is (significantly) lower. Formally, this contingency, or strength of association, between $C$ (e.g. tone) and $O$ (e.g. shocks) is measured by $P(O/C) - P(O/\neg C)$, abbreviated by $\Delta P_C^O$, where $P$ measures frequencies during the learning phase.\(^3\)

Other experiments in the aversive (i.e. fear) and appetitive conditioning paradigms (Thomas and LaBar, 2008) show that the speed of acquisition increases with the intensity of the shock. More generally, stronger emotions promote faster learning, more enduring memories, and stronger associations (Chatlosh et al., 1985). One could say that for trained rats, tones play

\(^3\)For a counterfactual analogue of contingency, see Pearl (2000). He shows that under some conditions (exogeneity and monotonicity), his counterfactual notion comes down to the standard statistical notion.
an important role in their categorization of shocks: the tone is a useful predictor and thus provides valuable information to the rat on how to prepare for the future. Moreover, this role of the tone in categorization becomes more entrenched with increased intensity of the shock.

Whereas early work in classical conditioning mostly involved animals, more recent work shows that humans learn associations between the representations of certain cues (properties or features) and outcomes (typically another property or a category prediction) in a very similar way (Gluck and Bower, 1988; Schanks, 1995). On the basis of these findings, on my preliminary proposal, I measure the representativeness of feature \( f \) for category or group \( G \) as the contingency between \( f \) and \( G \), \( \Delta P^f_G = P(f/G) - P(f/\neg G) \), where \( \neg G \) abbreviates \( \bigcup \text{Alt}(G) \) (and \( G \not\in \text{Alt}(G) \)). Then I will say that a feature \( f \) is representative for a group \( G \) in a particular context iff there is no relevant alternative feature \( g \) with a (significantly) higher contingency with \( G \) than \( f \), i.e., \( \neg \exists h \in \text{Alt}(f) : \Delta P^h_G > \Delta P^f_G \). Notice that a representative feature for group \( G \) doesn’t have to be one that most, or even many, members of the group have. Instead, a representative feature is one that distinguishes group \( G \) from its alternative(s) (for simplicity taken to be \( \neg G \)), which is exactly in line with the view on typicality discussed above: those features are representative for a group that highlight, or exaggerate, differences with other groups. Similarly, even though two features \( f \) and \( h \) are mutually incompatible for members of a certain group (e.g., no peacock both lays eggs and has fantastic blue-green tails), they can still both be representative, because they are distinguishable, for that same group.

Contingency is important for learning associations. Thus, it is the frequencies that animals and people were exposed to in the learning phase that count. But in many cases people are not exposed to the actual frequencies of cues (properties or features) with outcomes (typically another property or a category prediction), but rather with a distorted picture of it. Distortion is especially likely to happen when we learn associations through the (social) media. For instance, Kahneman (2011) notes that he had a long-held impression that adultery is more common among politicians than among physicians or lawyers. Only later he realized that this associative belief was probably caused by the fact that the extramarital relations of politicians are much more likely to be reported in the media than the affairs of lawyers and doctors. Still, it is only natural to assume that people will pick up associations from news items in a very similar way that people learn associations through actual exposure. This suggests that learning associations between cues with outcomes from the media also goes via contingency, our \( \Delta P^f_G \), but now the frequencies measure not the actual frequencies, but a distorted picture of them via media coverage which is strongly biased towards novelty and poignancy (cf. Kahneman (2011)).

Slovic et al. (2004), among others, argue that there exists a deeper link between representativeness of events or features and our emotional reactions to them. Events which give rise to fear and danger come easy to mind not only because of higher media coverage, but also simply because they give rise to strong emotional reactions. We have seen above that humans are, in this sense, not so different from the animals used in classical conditioning experiments: strong emotions like fear promote faster learning and more enduring memories. The empirical success of reinforcement learning in humans, again, only corroborates this idea.

To incorporate the insight of Slovic et al. (2004) and of fear-conditioning, I will extend our
earlier proposal and will define representativeness in a more general way. I will measure the representativeness of \( f \) for \( G \) by \( P(f/G) \times \text{Intens}(f) - P(f/\neg G) \times \text{Intens}(f) \), or equivalently \( \Delta P^f_G \times \text{Intens}(f) \), where \( \text{Intens}(f) \) measures the intensity of \( f \). I will abbreviate this measure by \( \nabla P^f_G \). Next I will say in our final proposal that \( f \) is among the most representative features of \( G \) iff there is no contextually salient alternative feature \( h \) which has a (significantly) higher measure of representability for \( G \), which I will say holds if \( \neg \exists h \in \text{Alt}(f) : \nabla P^h_G > \nabla P^f_G \). I normally assume that all relevant features have the same intensity, i.e. \( \forall h, h \in \text{Alt}(f) : \text{Intens}(f) = \text{Intens}(h) \). This means that under normal circumstances our notion of representability reduces to contingency, \( \nabla P^f_G = \Delta P^f_G \).

4 Weak Semantics: Generics state typicalities

In this section I will claim that a generic of the form ‘\( G \)s are \( f \)’ is true if \( f \) is a representative feature for \( G \). Therefore I make the following semantic claim:

- ‘\( G \)s are \( f \)’ is true iff there is no \( h \in \text{Alt}(f) : \nabla P^h_G \gg \nabla P^f_G \), where ‘\( \gg \)’ means ‘significantly larger’.

Observe that under any circumstance the generic sentence can only be true if \( \Delta P^f_G > 0 \), i.e., if the generic is true on Cohen’s relative reading.\(^4\) I claim that this general definition can account for the generics I discussed so far, due to the context dependence of various notions involved.\(^5\) To make that clear, let us first make some general observations concerning some special cases:

1. If \( \text{Alt}(f) = \{ f, \neg f \} \) and \( \text{Intens}(f) = \text{Intens}(\neg f) \), the generic ‘\( G \)s are \( f \)’ is true just in case \( \Delta P^f_G \gg 0 \), i.e., \( P(f/G) \gg P(f/\neg G) \), i.e., Cohen’s relative reading.\(^6\)

\(^4\)Instead of using standard contingency, it is tempting to make use of weighted contingency or representativeness instead. Let us just consider weighted contingency, defined as follows: \( \Delta^w P^f_G := \alpha P(f/G) - (1 - \alpha)P(f/\neg G) \), with \( \alpha \in [\frac{1}{2}, 1] \). Now one can define the (simplified) truth conditions of generics for which intensity is irrelevant as follows: ‘\( G \)s are \( f \)’ is true iff \( \neg \exists h \in \text{Alt}(f) : \Delta^w P^h_G > \Delta^w P^f_G \). One can show easily that in case \( \alpha = 1 \), Cohen’s (1999) absolute reading follows, while if \( \alpha = \frac{1}{2} \), the result is Cohen’s relative reading. This is certainly an appealing result. However, I won’t go for this proposal because (i) in contrast to our definition, if \( \alpha \neq \frac{1}{2} \) positive contingency, \( \Delta P^f_G > 0 \), is not required for generics to be true (which I think is undesirable), (ii) the use of the extra parameter \( \alpha \) only adds more context-dependence, and (iii) we can derive the relative reading without making use of \( \alpha \) and we can account for the generics that Cohen treats as absolute ones as well.

\(^5\)Sterken (2015) has recently argued that generics are more context dependent than is generally assumed: not only the domain of quantification is context dependent, but also the required force of quantification. Notice that on our analysis the required force of ‘quantification’ depends on context as well. How high \( P(f/G) \) must be in order for the generic ‘\( G \)s are \( f \)’ to be true depends on what \( \text{Alt}(G) \), and thus \( P(f/\neg G) \) is, what \( \text{Intens}(f) \) is and what \( \text{Alt}(f) \) is. Thus, I agree with Sterken that the required quantificational force for a generic to be true depends on context, but given our analysis of generics that is not something that should be build on top of the analysis: it just follows from the context dependence required anyway.

\(^6\)Proof: Under these circumstances the sentence is true iff \( \Delta P^f_G > \Delta P^\neg f_G \). For \( \Delta P^f_G > \Delta P^\neg f_G \) to be the case it has to hold that \( P(f/G) - P(f/\neg G) > P(\neg f/G) - P(\neg f/\neg G) \) iff \( P(f/G) - P(f/\neg G) > 1 - P(f/G) - (1 - P(f/\neg G)) \) iff \( P(f/G) - P(f/\neg G) > P(f/\neg G) - P(f/G) \) iff \( P(f/G) > P(f/\neg G) \).
2. If $\forall h \in \text{Alt}(f) : \text{Intens}(h) = \text{Intens}(f)$ and $P(f/G)$ is not high, ‘Gs are $f$’ is true just in case $P(f/\neg G)$ is very low, and thus $f$ is very distinctive for Gs.

3. If $\forall h \in \text{Alt}(f) : \text{Intens}(h) = \text{Intens}(f)$ and $P(h) \approx P(f)$, ‘Gs are $f$’ is true only if $\forall h \in \text{Alt}(f) : P(f/G) \gg P(h/G)$, or if $\Delta P^f_G$ is only somewhat above 0 and $\forall h \in \text{Alt}(f), P(h)$ is not low, $P(f/G)$ has to be (very) high (‘standard’ generics)$^7$

4. If $\Delta P^f_G$ is only somewhat above 0, and $P(f/G)$ is not high, $\text{Intens}(f)$ has to be high for ‘Gs are $f$’ to be true. (striking generics)

5. If $\text{Alt}(f) = \{f, \neg f\}$, $\text{Intens}$ is irrelevant and $\bigcup \text{Alt}(G) \cap f = \emptyset$, then ‘Gs are $f$’ is true just in case $P(f/G) > 0$, i.e., the existential reading.$^8$

Let us now look at some examples with the above cases in mind.

(1). If $\text{Alt}(f) = \{f, \neg f\}$ and $\text{Intens}(f) = \text{Intens}(\neg f)$, the generic ‘Gs are $f$’ is true just in case $\Delta P^f_G \gg 0$. Notice that this is already stronger than Cohen (1999)’s relative reading for which he argues to deal with sentences like ‘Dutchmen are good sailors’. However, I think even for these cases that the reading should be stronger. This is what we predict, especially if we assume that $\text{Alt}(f)$ can contain many other alternative features than just $\neg f$ (if it contains $\neg f$ at all). That is, the generic is true iff there is no relevantly salient $h$ that is a more distinguishing feature for being a $G$ than $f$ is. I claim that this is exactly not the case for examples like (9) ‘Dogs are 3-legged’ which indicated that Cohen (1999)’s relative reading of generics is too weak. Indeed, intuitively, one does not distinguish dogs from other pets by looking at whether or not they have three legs; checking whether they bark makes much more sense.

(2). A generic sentence ‘Gs are $f$’ is true if $f$ is very distinctive for Gs. I claim that a generic like ‘Tigers have stripes’ is considered true because ‘having stripes’ is (among the relative alternative features $\text{Alt}(f)$) among the most distinctive features of tigers. A generic sentence like ‘Germans are right handed’, on the other hand, is not predicted to be true simply because ‘being right handed’ does not distinguish Germans in any significant way from, say, other European citizens.

$^7$To show this, recall that $P(f/G) > P(f/\neg G)$ just in case $P(f/G) > P(f)$. It follows that if we only take features like $h$ into account such that $P(h) \approx P(f)$, $\Delta P^f_G > \Delta P^f_G$ just in case $P(f/G) \gg P(h/G)$. The same holds if we assume alternatively, and perhaps more naturally, that $\forall h \in \text{Alt}(f) : P(h/\bigcup \text{Alt}(G)) \approx P(f/\bigcup \text{Alt}(G))$. In both cases it means that $P(f/G)$ must be high.

$^8$For simplicity I will take $\text{Alt}(G) = \{\neg f\}$. Assuming that $\text{Intens}$ is irrelevant, we have to check whether $P(f/G) > P(f/\neg G)$ just in case $P(f/G) > P(f)$, which holds exactly if $P(f/G) > 0$. This reduces to $p > 0$, which holds easily if $P(f/G) > 0$: the existential reading. Recall that $P(f/G) > P(f/G)$ if $P(f/G) > P(f/G) > 0$. This suggests that generics with frequency adverbs like ‘Mammals seldom fly’ can be interpreted in terms of contingency as well with the same choice of $\text{Alt}(f) = \{f, \neg f\}$ and $\text{Alt}(G) = \{\neg f\}$. For the above generic to be true we demand that $1/2(\Delta P^G_G - \Delta P^G_G) < 1$, which comes down to $1/2(P(f/G) + P(f/G)) < 1$ and reduces to $P(f/G) < 1$, which is Cohen’s (1999) analysis. Alternatively, we can simply demand that $\Delta P^G_G < 1$, with $\text{Alt}(G) = \{\neg f\}$, although this would complicate a compositional analysis.
Our analysis accounts for the intuition that generics like ‘Birds fly’ and ‘Birds lay eggs’ are acceptable and true. The reason is that ‘flying’ and ‘laying eggs’ are indeed among the most distinguishable features for birds (compared to alternative middle sized animals). Our semantic analysis of generics also explains the following example that is paradoxical to many other theories: although only (adult) male lions have manes, (11a) is an accepted generic, but (11b) is not.9

(11) a. Lions have manes.
    b. Lions are male.

The reason is that compared to lions, relatively few other animals have manes, but it is not the case that compared to other animals relatively many lions are male. Our analysis thus correctly predicts that ‘Gs are f’ can be true and ‘Gs are h’ false, although $P(h/G) > P(f/G) < \frac{1}{2}$.

I have proposed that generic sentences should be analyzed in terms of representativeness, and that the representativeness of feature $f$ for group $G$ should be measured by $\Delta P_G^f$. I have noted before that this reduces to contingency, $\Delta P_G^f$, if $\forall f, g \in \text{Alt}(f): \text{Intens}(f) = \text{Intens}(g)$. Notice, now, that $\Delta P_G^f$ behaves very similar to two other interesting measures, $\frac{P(f/G)}{P(f)}$ and $\frac{P(f/G)}{P(f/\neg G)}$.10 It is remarkable that $\frac{P(f/G)}{P(f)}$ and $\frac{P(f/G)}{P(f/\neg G)}$ have been proposed as measures of stereotypicality of $f$ for $G$ within social psychology (McCauley et al., 1980; Schneider, 2004). Indeed, just like $\Delta P_G^f$, also $\frac{P(f/G)}{P(f)}$ and $\frac{P(f/G)}{P(f/\neg G)}$ give those features a high value that are distinctive for group $G$, and thus highlight or exaggerate differences between groups. From this proposal, together with our own, it naturally follows that in case $\Delta P_G^f$ is high, we could say that $f$ is a stereotypical feature of $G$. Is that already enough evidence to propose that ‘Gs are f’ is a good and true generic?

Indeed, a number of authors, including Declerck (1996) and Geurts (1985), have proposed that generics are about stereotypical properties. This account has been criticized by Krifka et al. (1995), however, and is largely abandoned in the literature. A first argument used by Krifka et al. (1995) is that stereotypes are just widely acknowledged ideas within a speech community, while the truth of a generic depends on actual facts: even if uttered in a culture where everybody believes that cows are a special kind of horse, or that snakes are slimy, they argue, cows are not horses, and snakes are not slimy. This argument is obviously invalid with respect to our analysis of stereotypes, however, if I base my analysis not on a subjective probability function, but on objective frequencies, or propensities. The truth of a generic is then predicted to depend on actual facts. A second counterargument of Krifka et al. (1995) is that stereotypes are tied to well-known groups or situations, while generics are often not about any of those things. But, again, I don’t see why this could be problematic for our analysis. A third counterargument is

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9This example is strikingly similar to the famous conjunction fallacy of Kahneman and Tversky (1972). In the next section I will show that our analysis accounts for the two ‘paradoxes’ in the very same way, in terms of our implementation of Tversky and Kahneman (1974)’s representativeness-heuristics making use of contingency.

10Contingency increases with increasing $P(f/G)$ and decreasing $P(f/\neg G)$ just as $\frac{P(f/G)}{P(f)}$. Next, one can show that contingency, $\Delta P_G^f$, behaves monotone increasing with respect to the standard notion of relevance, $P(f/G) - P(f)$. Obviously, $\frac{P(f/G)}{P(f)}$ increases with increasing $P(f/G)$ and decreasing $P(f)$, just as $P(f/G) - P(f)$.
the fact that although the stereotype states that Hindus don’t eat meat, a generic like ‘Hindus
eat meat’ can be true in certain contexts, e.g. as a rejection of the claim that no Hindu eats
meat. I agree with the linguistic intuition, but along with Cohen (2004) I think that the truth of
this use of the generic is peculiar to its use of rejections. I will come back to this problem later
in this section. For now, I conclude that the standard arguments against an analysis of generics
in terms of stereotypicality are not valid on our implementation of the latter notion.

Our analysis of generics is based on typicality and as such is very similar to an analysis based on
prototypicality as well. But the linguistic literature has not been friendly to such an approach.
How could I still defend it? Let’s see whether we can rebut the troubles typically discussed for
such an analysis. First, this approach is criticized for simply passing on the problem of generics
to a new problem of what it means to be prototypical. But this can’t be a serious
problem anymore, given our very explicit proposal, based on psychological research, for what
it means to be (proto)typical. A second problem normally discussed is that this approach cannot
deal with the fact that the following two sentences both seem to be true:

\[(12)\]
\[
a. \text{Peacocks have fantastic blue-green tails.} \\
b. \text{Peacocks lay eggs.}
\]

The reason why this example is taken to be a problem is that the proposal to handle generics
in terms of prototypicality is mostly taken to be that the sentence ‘Gs are \(f\)’ is true just in
case the prototypical Gs have feature \(f\). Hence: ‘Tigers have stripes’ is true if and only if all
(proto)typical tigers have stripes. Natural as such an analysis might be, it falsely predicts that
(12a) and (12b) cannot both be true, because it is not the case that the typical peacock both has
a blue-green tail and lays eggs, simply because there is no peacock that is male \textit{and} female.
Fortunately, my analysis differs from the one that is criticized. According to my analysis it is
possible that ‘Gs are \(f\)’ and ‘Gs are \(h\)’ are true, even though \(f\) and \(h\) are, in fact, incompatible.
It only has to be the case that \(\neg \exists g \in \text{Alt}(f) : \Delta P^g_G > \Delta P^f_G\) and \(\neg \exists g \in \text{Alt}(h) : \Delta P^g_G > \Delta P^h_G\), where
the sets of alternative features \(\text{Alt}(f)\) and \(\text{Alt}(h)\) could be, though need not be, the same. This,
obviously, is very well possible: relative to other animals (in general), many peacocks have
beautiful blue-green tails and many peacocks lay eggs.\footnote{Leslie (2008) provides a stronger argument against the prototype theory. She argues that not only (7a) and (7b) are true, but also ‘Peacocks have fantastic blue-green tails and lay eggs’. Perhaps a more convincing example is given by Nickel (2010): ‘Elephants live in Africa and Asia’. Note that on our analysis it might well be possible that for two mutually incompatible features like \(f\) and \(h\) it could be that \(\neg \exists g \in \text{Alt}(f) : \Delta P^g_G > \Delta P^f_G\) and \(\neg \exists g \in \text{Alt}(h) : \Delta P^g_G > \Delta P^h_G\), even if \(\text{Alt}(f) = \text{Alt}(h)\). What is obviously not possible on our analysis is that for the conjoined feature \(f \land h\) it holds that \(\neg \exists g \in \text{Alt}(f) : \Delta P^g_G > \Delta P^{f\land h}_G\). Thus, for such cases, ‘\(\land\)’ must have wide scope.} What is predicted not to be possible
is that both ‘Gs are \(f\)’ and ‘Gs are \(\neg f\)’ are true (if \(\neg f \in \text{Alt}(f)\) and \(f \in \text{Alt}(\neg f)\)), which is as
it should be according to Hoeltje (2017).

(3). Recall that on our analysis \(f\) is a representative feature of \(G\) if \(f\) is very distinctive for
\(G\). However, it seems that some generics of the form ‘Gs are \(f\)’ are true, without \(f\) being a
very distinctive feature. This holds, arguably, for (13a)-(13d), which are all undoubtedly good
generics:
(13) a. Humans are mortal.
b. Birds are warm blooded.
c. Dogs are 4-legged.
d. Lions are mammals.

Intuitively, these generics are true simply because the vast majority of the mentioned animals have the relevant features. Our analysis can account for such cases as well. Notice, first, that although in all the above cases having the feature \( f \) hardly distinguishes the animals involved, \( Gs \), from their alternatives, \( \cup Alt(G) \), it is still the case that \( P(f/G) > P(f/\cup Alt(G)) \) (taking some immortals into account for (13a)), and thus the feature is predicted to be associated with \( G \), even if not in a maximal way.\(^{12}\) Second, in examples (13a) and (13b) it is only reasonable to assume that \( Alt(f) = \{ f, \neg f \} \), and thus \( P(f/G) > P(f/\cup Alt(G)) \) is already enough to make the sentences true. If \( P(f/\cup Alt(G)) \) is high, it just means that \( P(f/G) \) has to be very high, which indeed is the case. Third, the features involved in (13c) and (13d) (and in (13a) and (13b)) are rather common among all animals. If we only take other such features into account as well (0-legged, 2-legged and birds, fish, reptiles, amphibians), it is demanded on our analysis for ‘\( G \) is \( f \)’ to be true that \( P(f/G) \) is very high (assuming \( Intens \) to be irrelevant).

Still, it seems that the analysis as it stands is not quite appropriate for examples like (13a)-(13d). For other generics our analysis required that the measure of representativeness, \( \nabla P_G^f = \Delta P_G^f \times \text{Intens}(f) \) is high. For the above examples, however, that doesn’t hold: \( \text{Intens} \) seems irrelevant, and the features are not really distinctive, meaning that \( \Delta P_G^f \) is low (though positive). Fortunately, one can define a measure closely related to \( \Delta P_G^f \) (adopted from Shep (1958)), called ‘relative difference’ and denoted by \( \Delta^\star P_G^f \), which will have the result that the resulting \( \nabla P_G^f \) (where in its definition \( \Delta P_G^f \) is replaced by \( \Delta^\star P_G^f \)) will be high:

\[
\bullet \quad \Delta^\star P_G^f \overset{df}{=} \frac{\Delta P_G^f}{1 - P(f/\cup Alt(G))}
\]

Replacing \( \Delta P_G^f \) in the definition of \( \nabla P_G^f \) by \( \Delta^\star P_G^f \) will mean that contingency, and thus distinctiveness, still plays a major role: for \( \Delta^\star P_G^f > 0 \) it is required that \( \Delta P_G^f > 0 \), and high \( \Delta P_G^f \) still results in high \( \Delta^\star P_G^f \). However, it has the extra effect that \( \Delta^\star P_G^f \text{ increases} \), if \( P(f/\cup Alt(G)) \) increases. For instance, if \( P(f/\cup Alt(G)) = 0.9 \), \( \Delta^\star P_G^f \) will be ten times as high as \( \Delta P_G^f \) (if \( \Delta P_G^f > 0 \)).

Thus, for relatively common features (as in examples (13a)-(13d)) it has the effect that \( \Delta^\star P_G^f \) will be high, even though \( \Delta P_G^f \) is relatively low. More intuitively, the use of \( \Delta^\star P_G^f \) instead of \( \Delta P_G^f \) has the consequence that for representativeness of \( f \) for \( G \), the value \( P(f/G) \) is more important than \( P(f/\neg G) \).\(^{13}\)

(4) Next, if \( \Delta P_G^f > 0 \) but small, and \( P(f/G) \) is not high, \( \text{Intens}(f) \) has to be high for ‘\( Gs \) are \( f \)’ to be true. Recall that \( \text{Intens} \) was brought in to take over some insights from fear-conditioning.

\(^{12}\)This distinguishes these examples from a sentence like ‘Germans are right handed’.

\(^{13}\)Although the general approach should be stated in terms of \( \Delta P_G^f \), for simplicity I won’t make use of in the rest of this paper, because nothing in the further discussion of this paper relies on it.
I claim that it is exactly this that makes our analysis immediately account for **striking generics** like (6a) ‘Ticks carry the Lyme disease’ which are problematic for default-based approaches (e.g. Asher and Morreau (1995)). Indeed, Leslie (2008) notes that ‘striking’ often means ‘horrific or appalling’, which means having a high *Intens*.

A feature can be striking also just because it is very peculiar, i.e., uncommon. Learning that members of a group have this peculiar feature more than on average can be very interesting. Making use of Shannon’s Information Theory, I will say that *A* is peculiar exactly if *A*’s informativity, inf(*A*), is high. The latter notion is defined as \( \log_2 \frac{1}{P(A)} = - \log_2 P(A) \). According to this definition, inf(*A*) receives a high value exactly if \( P(A) \) is small. \( \nabla P^f_G \) now comes down to \( [P(f/G) - P(f/\neg G)] \times \inf(f) \). 14 If *f* is a very common feature, \( \inf(f) \) will be small and \( \nabla P^f_G \) can be high only if \( \Delta P^f_G \) is high. For very uncommon features for members of *G* and their alternatives, however, \( \nabla P^f_G \) can be high even if \( \Delta P^f_G \) is low (but > 0). I claim that this is going on for (at least some) **relative generics** like (7a) ‘Frenchmen eat horsemeat’.

(5) Earlier in this section I mentioned an example of a generic statement like (14) that is, intuitively, interpreted **existentially**, and noted that according to Krifka et al. (1995) this shows a problem for any analysis of generics based on stereotypicality. Existential generics like (14) (from (Cohen, 1999)), however, seem to pose a problem for nearly any analysis of generics.

(14)  
A. No Indian eats beef.  
B. No! Indians [do] \( \_\_ \) eat beef.

Cohen (2004), however, is able to account for existential readings of generics by assuming that these are interpreted on his absolute reading with \( \text{Alt}(f) = \{f\} \). Although formally appealing, the proposal looks conceptually artificial. For one thing, the focal stress on the verb *do* suggests that \( \neg f \) should be an element of \( \text{Alt}(f) \) as well. What is clear, though, is that for the interpretation, only Indians count, which seems to suggest that our **contrastive** analysis is not well suited to the situation. As shown in a previous footnote, however, I can account for existential readings formally by assuming that \( \text{Intens} \) is irrelevant, \( \text{Alt}(f) = \{f, \neg f\} \) and \( \text{Alt}(G) \) is such that \( \bigcup \text{Alt}(G) \cap f = \emptyset \). Intuitively this seems correct, because the natural way to think about \( \bigcup \text{Alt}(G) \) is as the set of Indians that verify what is said by A: the Indians that don’t eat beef. The result is that the generic in (14) is interpreted as saying that more Indians eat beef than expected.

Let us finally consider **non-descriptive generics** like (8a) ‘Bishops move diagonally’. At least since Kripke we know that identity statements can be used in two different ways: (i) to state the identity of meaning (intension) of the two terms, or (ii) to fix the meaning of one term in terms of the meaning of the other. Kripke explains the *a priori* character of a sentence like ‘Stick *S* is one meter long’ when talking about the ideal stick, or standard meter, preserved in Paris ever since the French Revolution by the second use of identity statements. Generic sentences are much like identity statements and can be used in those two similar ways. On a definitional use

14 What \( \inf(f) \) is meant to measure is the informativeness that an arbitrary *x* has feature *f*. 

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**Generics and typicality**
of generics of the form ‘Gs are f’, this means that having $f$ is a necessary condition for being a $G$. If the definition is complete, $f$ is also a sufficient condition. Note that if ‘Gs are $f$’ is a complete definition of $Gs$, $f$ is a feature that all and only all $Gs$ must have. But this means that $\Delta P_G$ will have the maximal value, because in that case $P(f/G) = 1$ (the maximal score) and $P(f/\neg G) = 0$ (the minimal score). This suggests that for definitional, or constitutive, uses of generics, just like for descriptive generics, contingency plays a crucial role!

Not all non-descriptive generics are constitutive in an equally strong manner as (8a) and ‘Keys open doors’, where without such generics bishops and keys would not even exist. Consider examples like the following:

(15)  
   a. Boys don’t cry.
   b. Gentlemen open doors for ladies.

Leslie (2015) argues that (15a), at least on its normative reading, is used to tell a boy that crying is not an appropriate behavior for him and that he should hold back his tears: the sentence says something about what it takes, according to the speaker, to be an ideal boy. This picture is reminiscent of the way we categorize goal-derived categories according to Barsalou (1985), and we have seen that what are typical features for such a category are features that do a good job of distinguishing members from this category from members from others. But obviously, this is exactly what our analysis of generics is meant to do in the first place. This suggests that, just like for descriptive generics, contingency $\Delta P_G = P(f/G) - P(f/\neg G)$ should play an important role for normative generics like (15a) and (15b) as well.

But what, then, does distinguish normative from descriptive generics? What distinguishes the two types of generics, I would like to claim, is exactly the fact that the generics of the former type are not descriptivel. More precisely, the probabilities involved in normative generics measure normative expectations rather than actual propensities. If so, it immediately follows that $\Delta P_G$ is high for such a generic of the form ‘Gs are $f$’, and thus that except for the interpretation of $P$, we could interpret non-descriptive generics in exactly the same way as descriptive generics.

Intuitively, normative expectations do not only involve beliefs, i.e., expectations measured by probabilities, but also desires. Indeed, I would think it is natural to claim that (15a) is really about desirable features for boys. With a slightly more general definition of $\nabla P_G$ we can account for this. Let us redefine $\nabla P_G$ in a slightly more general way than we have so far as $(P(f/G) \times \text{Value}(f/G)) - (P(f/\neg G) \times \text{Value}(f/\neg G))$. A user of (15a) values it highly if boys don’t cry, i.e., if $\text{Value}(\neg \text{cry}/\text{Boys})$ is high, although for this speaker $\text{Value}(\neg \text{cry}/\text{Girls})$ might as well be low. Assuming that $P(\neg \text{cry}/\text{Boys}) \approx P(\neg \text{cry}/\text{Girls})$ with $P$ just measuring expectations, it still follows that $\nabla P_{\text{Boys}}$ is high, and the speaker signals that (s)he wants boys not to cry.
5 Strong Pragmatics: from biases to probabilities

On the basis of experimental evidence, Cimpian et al. (2010) concluded that to accept a generic about a group we are familiar with, relatively weak conditions have to be fulfilled. At the same time, Cimpian et al. (2010) have observed that hearers interpret generics in a much stronger way: (almost) all $G$s are $f$. This holds especially if this generic is about a relatively unknown group. What could explain this strong interpretation?

Our proposal is that this is due to the fact that people generally confuse representativeness (or stereotypicality) with probability (or prototypicality). This idea might seem ad hoc, but it is in fact at the heart of the whole Biases and Heuristics program of Tversky and Kahneman (1974), and the confusion between contingency and probability is explicitly argued for in the more recent Associative Theories of Probability Judgement. The first program started with Tversky and Kahneman showing that our intuitions involving probability judgements are not in accordance with the norms given by Bayesian probability theory.

Bayesian probability theory is a prescriptive theory. Unfortunately, it doesn’t seem descriptively adequate. The conjunction fallacy of Kahneman and Tversky (1972) shows that in some situations people assign greater probability to a conjunction than to one of its conjuncts, i.e., $P(B \land F) > P(B)$, although this is impossible according to the normative Bayesian theory. For example, a woman (Linda) with liberal political views was judged by most participants to be more likely a feminist bank teller than a bank teller. According to their Biases and Heuristics program (Tversky and Kahneman (1974)), to reach a probability judgement, we often do not reason according to Bayesian probability theory, but use simplifying or shortcut heuristics. These heuristics are mostly approximately correct, but also give rise to systematic biases in certain contexts.

We have seen above that the contingency, or associative strength, between cue $C$ and outcome $O$ is measured by $\Delta P^O_C = P(O/C) - P(O/\neg C)$. The Associative Theories of Probability Judgements (Gluck and Bower, 1988; Lagnado and Shanks, 2002) now make the further claim that the subsequent probability judgments are then based on these associations. Although the contingency between $C$ and $O$ might be very different from the conditional probability of $O$ given $C$, association theories of probability judgements claim that when people are asked a question about probability, they readily substitute this with the closely related question about evidential support, or contingency, which sometimes gives rise to an incorrect response. Lagnado and Shanks (2002) show that the Associative Theory of Probability Judgements can account for the conjunction fallacy. In a similar way, associative theories of probability judgments can explain

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15 Of course, $\Delta P^O_C$ can be anywhere between $-1$ and $1$, whereas probabilities need to be between $0$ and $1$. How can $\Delta P^O_C \times P(O/C)$ be turned into a probability? For such cases, normally a logistic function is used, a transformation function that turns measures from $[-\infty, \infty]$ into $[0, 1]$ such that everything below $0$ goes to somewhere below $\frac{1}{2}$ and analogously to everything above $0$.

16 To give a telling example from Newel et al. (2007), suppose that a football team is as likely to win as to lose when Johan plays, but that the team much more likely loses when Johan is not playing. In that case, although $P(\text{win}/\text{Johan plays}) = P(\neg \text{win}/\text{Johan plays})$, still people typically will believe that the team will win if Johan is playing.
other ways people deviate from the normative Bayesian theory, such as the fact that people tend to neglect base rates.

The problem I wanted to account for in this section is to explain why people generally interpret generics of the form ‘Gs are f’ as holding that \( P(f/G) \) is high. Our analysis merely predicts that the sentence is true iff \( \nabla P^F_G \) is high, which means that \( [P(f/G) - P(f/\neg G)] \times Intens(f) \) is high. Given the Associative Theory of Probability Judgements, the gap between the two can easily be bridged in case all features have the same value. Recall that if the value of the features is irrelevant, high \( \nabla P^F_G \) reduces to a high contingency. By the Associative Theory of Probability Judgements, however, this is confused with high \( P(f/G) \), which explains the common intuition under these circumstances.

What if the intensities of the features might be important, i.e., if the relevant features are ‘horrific’, ‘appalling’, or ‘peculiar’? According to Tversky and Kahneman (1974) availability heuristics, people assess the probability of an event by the ease with which instances or occurrences can be brought to mind. Usually this heuristic works quite well; all things being equal, common events are easier to remember or imagine than uncommon events. Unfortunately, sometimes the general rule of thumb doesn’t do its job and leads to systematic biases. Some events are more available than others not because they tend to occur frequently or with high probability, but simply because they are inherently easier to think about. Emotionally-charged events, or horrific or appalling features, can be brought to mind easily. Presumably, the same will hold for other newsworthy events or features, in particular for the peculiar ones. Thus, by the availability heuristics, \( P(f/G) \) and \( P(f/\neg G) \) are considered higher than they actually are, if \( Intens(f) \) is high, and the same will thus be the case for the contingency \( \Delta P^F_G \). But this means via the associative theory of probability judgement again that \( P(f/G) \) is considered higher than it actually is, perhaps close to 1.

Thus, I have argued that hearers that are unfamiliar with group G interpret a generic of the form ‘Gs are f’ in a much stronger way than one would expect according to the semantic analysis I defended in the previous section, because they confuse representative features, features f where \( P(f/G) - P(f/\neg G) \times Intens(g) \) is high, with probable feature, features f where \( P^*(f/G) \) is high. In the last formula, \( P^* \) models subjective belief rather than objective frequencies or propensities. Obviously, if \( P^*(f/G) \) is high, we have explained why the generic ‘Gs are f’ is interpreted as meaning that almost all Gs are f.

There is yet another reason as to why a high representativeness, or contingency, between G and f increases the felt conditional probability \( P(f/G) \), i.e., \( P^*(f/G) \). Note, first, that it is, or at least was, quite common among psychologists and philosophers of science to use \( \Delta P^F_G \) to measure the causal strength of G for f. Second, Tversky and Kahneman (1980) show that if we see a correlation, we tend to interpret it in the preferred (strongest) way: as causal. Moreover, they show that an event is seen as more likely than it actually is, if it can be understood: if it can be causally explained. This, then, is the causality bias: high representativeness of a feature for G as we measured it, leads to higher subjective probability given G than is justified, because we believe that there exists a causal relation between G and f.
This last reason why high representability leads to high conditional probability is closely related with proposals of Barth (1971), Leslie (2015) and Haslanger (2010, 2014) why we (and children in particular) interpret generics typically in such a strong way. Haslanger (2014) argues that if we use a generic like ‘Women are more nurturing than men’, we (wrongly) implicate that there is something about what it is to be a woman and about what it is to be a man that explains their supposed differential capacities to nurture. From this she concludes that the utterance of a generic of the form ‘Gs are f’ will normally add to the common ground of the conversation a claim about f’s naturalness for the group, or kind, G. The generic is (wrongly) taken to be true because of Gs essence. Haslanger (2014) and Leslie (2015) argue that this is why it is dangerous to claim ‘Muslims are terrorists’ but not ‘Ticks carry the Lyme disease’: while for the latter essentialists belief might be true, this is certainly not the case for the former. Although I agree with Barth (1971), Haslanger (2014) and Leslie (2015) that essentialist beliefs play a pragmatically significant role in why we interpret generic statements in such a strong way, I don’t think this is the whole reason: it is only one of the biases singled out by Tversky and Kahneman (1974) that are crucial.

6 Conclusion and outlook

In this paper I have based my analysis of generic sentences primarily on an intuition that some authors over the years have claimed would be natural for at least some examples (e.g. Krifka et al. (1995)): a generic of the form ‘Gs are f’ is true iff f is a typical, distinguishing, feature for Gs. Many analyses of generics have been proposed over the years, and none has come out as the clear winner. This is partly due, I suspect, to the vagueness and context-dependence of what is meant by a generic. I have little doubt that my proposal won’t meet universal acceptance either. Still, I hope that this paper at least shows that an analysis in terms of typicality can be pushed much further than is generally assumed. I also argued that such a semantic analysis is naturally extended by pragmatic strengthening, making use of insights from Tversky & Kahneman’s Heuristics and Biases approach. This popular approach within social and cognitive psychology (as measured by the selling rates of Kahneman (2011)), has, to the best of my knowledge, never been used so far in pragmatics. I think this is a shame, and I hope this paper will help to change things accordingly.

References


(Eds.), *Handbook of Logic and Language*, pp. 1125–1177. Amsterdam: North Holland.
Abstract. Recent work by Sudo (2012) and Klinedinst (2016) proposes a new perspective on differences between classes of presupposition triggers, with an empirical split roughly mirroring Abusch’s (2002) hard vs. soft distinction and related notions. These two authors propose that triggers differ in whether or not their presuppositional content simultaneously affects the calculation of the presuppositions and of the entailments of the sentences in which they appear. Drawing on a proposal by Glanzberg (2005) we formulate the Removability/Independence Hypothesis: triggers that do not affect entailments are triggers that can be left out of sentences without affecting interpretability. We experimentally test the hypothesis by embedding return, (go) again and (go) back in non-monotonic environments, which Sudo argues to elicit differences in presuppositions and entailments. Our results provide clear evidence against the RI hypothesis: whereas only the trigger return is crucial for the sake of interpretability, all three triggers produced similar results. At the same time, data for the triggers stop and also, included as controls, lend further support in favor of Sudo’s entailment-contrast proposal.

Keywords: presuppositions, entailment, hard/soft distinction.

1. Introduction

As evident from (1), start, stop and too all trigger a presupposition: while a speaker can ask (1a) and remain agnostic as to whether Mei fought criminals before (and after) she graduated, they make a commitment about her pre-graduation habits when asking (1b), (1c) or (1d). Indeed, despite the interrogative aspect of these sentences, a speaker asking (1b) takes for granted that Mei did not fight criminals before graduating and, likewise, a speaker asking (1c) or (1d) takes for granted that she did fight criminals before she graduated. The presupposition is said to project: it survives embedding under a question operator.²

(1) a. Did Mei fight criminals after she graduated?
   b. Did Mei start fighting criminals after she graduated?
   c. Did Mei stop fighting criminals after she graduated?
   d. Did Mei fight criminals after she graduated too?

Since Abusch (2002), it has been standard to assume a division between so-called hard and soft presuppositions. Abusch proposes that there is a categorical difference between presuppositions like those of start and stop on the one hand, and presuppositions like those of too on the other hand. She remarks that even though start and stop associate with contradictory presuppositions, a speaker can utter (2a) without suffering contradiction, with the resulting interpretation

1We gratefully acknowledge support from NSF-grant BCS-1349009 to Florian Schwarz. We thank the audience at the workshop Theoretical and Experimental Approaches to Presuppositions in Genoa, the audience at Sinn und Bedeutung 22, and the members at the lab meeting at UPenn for their comments.

2The phrase after she graduated arguably also introduces the presupposition that Mei graduated. We will ignore this in the rest of this paper.
in (2b). This stands in contrast with (3a), where the presuppositions that *too* triggers (that she fought/supported criminals after she graduated) from each disjunct also stand in a relation of contradiction, thereby making (3a) a contradictory utterance. Abusch’s conclusion is that *start* and *stop* are soft triggers whose presuppositions can easily be suspended for the sake of discourse felicity (as in (2)) whereas *too* is a hard trigger whose presuppositions project even when leading to discourse contradiction as in (3).

(2)  
   a. Mei either started fighting criminals after she graduated, or stopped fighting criminals after she graduated.
   b. Mei either [didn’t fight criminals before she graduated and] started afterwards, or [fought criminals before she graduated and] stopped afterwards. = (2a)

(3)  
   a. ? Mei either supported criminals after she graduated too, or fought criminals after she graduated too.
   b. Mei either [supported criminals before she graduated and] did so afterwards too, or [fought criminals before she graduated and] did so afterwards too. ̸= (3a)

Granted that presuppositions come either as hard or soft, the problem is twofold: i) what are the characteristics of presuppositions that make them easily suspendable (soft) or more persistent (hard) and ii) what systematic principles, if any, govern the mapping of triggers onto being either hard or soft? Abusch only offers an answer to the first question.\(^3\) She proposes that soft presuppositions are derived through pragmatic means, whereas hard presuppositions are encoded into the semantics of their lexical triggers. The assumption is that contextual factors can block the pragmatic derivation of a presupposition but cannot obviate the constraints that lexical items impose on the compositional computation of a sentence’s semantic value.

While Abusch’s proposal constitutes an explanatory account of why soft and hard presuppositions differ in terms of suspendability, it leaves the second aspect of the problem unresolved, namely what properties of expressions associate them with soft rather than hard (e.g., *stop*), or hard rather than soft presuppositions (e.g., *too*).\(^4\) In this paper, we consider a proposal by Klinedinst (2016: see also Sudo 2012) that develops an answer to the first question independently from Abusch’s analysis, and a proposal by Glanzberg (2005: see also Zeevat 1992) that offers a possible answer to the second question. We consider the possibility of linking the two proposals by formulating what we call the *Removability/Independence Hypothesis* and proceed to experimentally test its predictions. While our results support the existence of a contrast opposing the trigger *stop* to the triggers *also* and *again* along a Sudo-Klinedinst split line, they reveal that the trigger *return* patterns with *also* and *again* rather than with *stop*, contra the predictions of our *Removability/Independence Hypothesis*. As a conclusion, we give a critical review of some of the current theories of presuppositions in light of our results.

\(^{3}\)Though see her footnote 5 for hints at possible answers to the second question.

\(^{4}\)From this point on we extend Abusch’s terminology of soft vs. hard presuppositions in a way that respectively associates them with soft vs. hard triggers.
2. Entailing vs. Non-Entailing Presupposition Triggers

2.1. Theoretical Background

In this paper, we will adopt Heim and Kratzer’s (1998) notation of semantic values, which distinguishes domain conditions (in boldface, our emphases) from truth conditions (underlined, our emphases). (4) illustrates this notation: (4b) is a formal representation of the semantic value of (4a). The presupposition that Mei used to fight criminals before graduation is represented by the boldface domain condition. The underlined truth conditions represent the proposition about Mei fighting criminals after graduation. Operators like interrogation or disjunction target truth conditions but leave domain conditions unaffected, resulting in presupposition projection.

(4) a. Mei fought criminals after she graduated too.
   b. \[
      [[(4a)]] = \lambda w : \exists t < t_{\text{grad}} \text{fight-criminals}(m, t, w). \text{fight-criminals}(m, t_{\text{grad}}, w).
   \]

In (2), the second disjunct containing the trigger stop, repeated in (5a), appears to lack a presupposition. We represent its apparent semantic contribution to (2a) in (5b): what appears as a domain condition in (4b) appears as part of the truth-conditions in (5b).

(5) a. Mei stopped fighting criminals after she graduated.
   b. \[
      \lambda w. \exists t < t_{\text{grad}} \text{fight-criminals}(m, t, w) \land \neg \text{fight-criminals}(m, t_{\text{grad}}, w).
   \]

Were we unaware of the presuppositional properties of stop, a natural conclusion from the observation of (5a) receiving the interpretation in (5b) would be to say that stop conveys only the truth conditions in (6).

(6) \[
   \lambda P. \lambda x. \lambda w. \exists t < t_0 P(x, t, w) \land \neg P(x, t_0, w).
\]

However, we have already established with (1c) that stop presupposes that its complement predicate was true of its subject at a previous time. A possible refinement would be to say that (7) is a more accurate representation of the lexical entry of stop, and posit an operation that can convert domain conditions into truth-conditions, which would derive (6) from (7). Speakers using (5a) in the disjunction (2a) could then apply that operation, and standard rules of composition would associate the stop disjunct with the semantic value in (5b).

(7) \[
   \lambda P. \lambda x. \lambda w : \exists t < t_0 P(x, t, w). \neg P(x, t_0, w).
\]

What we just described has been a standard approach since Heim (1983), who introduces this notion of conversion as local accommodation. It facilitates starting from a lexical representation of stop as in (7) so as to account for presuppositional uses as in (1c) while also accounting for non-presuppositional uses as in (2a) at the same time.

One pitfall of this approach in light of the contrast elicited by Abusch is that, as things stand, it would predict non-presuppositional uses of too to the same extent as there are non-presuppositional uses of stop. If local accommodation can convert any domain condition into
truth condition, then (4a) should also associate with an alternative version of (4b) where the
boldface domain conditions appear as part of the underlined truth conditions, in a way parallel
to (5b). A direct, unwelcome prediction is that the *too* disjunction (3a) should receive the
non-presuppositional interpretation in (3b) in the same way that the *start/stop* disjunction (2a)
receives the non-presuppositional interpretation in (2b). Since this is not the case, the only
solution to account for the contrast is to stipulate that *too* resists local accommodation in a way
that *stop* (and *start*) do not.

Klinedinst (2016) offers an alternative explanation. Rather than revising (6) as a semantic value
for *stop* in favor of (7), Klinedinst proposes to enrich it with a domain condition as in (8).

(8) \[ [[\text{stop}]] = \lambda P. \lambda x. \lambda w. \exists t < t_0 \ P(x, t, w). \exists t < t_0 \ P(x, t, w) \land \neg P(x, t_0, w). \]

Such a lexical entry does not straightforwardly account for apparent non-presuppositional uses
of *stop*, and Klinedinst therefore also needs to posit an operation to prevent domain conditions
from projecting and giving rise to a presupposition in the case of the *stop/start* disjunction (2a).
One could make use of the operation of conversion that we described earlier, but note that that
operation of conversion can be described as a two-step process: first make a copy of the domain
conditions into the truth conditions, second delete the domain conditions. Only the second step
is required when starting from the lexical entry in (8). (9) illustrates the one-step process.

(9) a. \( \lambda P. \lambda x. \lambda w. \exists t < t_0 \ P(x, t, w). \exists t < t_0 \ P(x, t, w) \land \neg P(x, t_0, w). \)
   b. \( \lambda P. \lambda x. \lambda w. \exists t < t_0 \ P(x, t, w). \exists t < t_0 \ P(x, t, w) \land \neg P(x, t_0, w). \) \hspace{1cm} \text{DELETION}
   c. \( \lambda P. \lambda x. \lambda w. \exists t < t_0 \ P(x, t, w) \land \neg P(x, t_0, w). \)

In our view, the main advantage of Klinedinst’s approach over the standard approach does not
come from reducing the complexity of the posited operation. After all, the price to pay for
a simpler operation is to posit a richer, somewhat redundant lexical entry for *stop*: the same
proposition appears both as a domain condition and as a truth condition. The very welcome
consequence of Klinedinst’s position becomes evident when one considers non-redundant se-
mantic values, that is, semantic values where domain condition propositions do not appear as
part of the truth conditions. Let us compare the alternative semantic values to the one we gave
for the *too* disjunct in (4b) after conversion (10) versus after deletion (11).

(10) Mei fought criminals after she graduated too.
    a. \( \lambda w. \exists t < t_{\text{graduate}} \textbf{fight-criminals}(m, t, w). \textbf{fight-criminals}(m, t_{\text{graduate}}, w). \)
    b. \( \lambda w. \exists t < t_{\text{graduate}} \textbf{fight-criminals}(m, t, w). \) \hspace{1cm} \text{CONVERSION}
       \[ \exists t < t_{\text{graduate}} \textbf{fight-criminals}(m, t, w) \land \textbf{fight-criminals}(m, t_{\text{graduate}}, w). \]
    c. \( \lambda w. \exists t < t_{\text{graduate}} \textbf{fight-criminals}(m, t, w) \land \textbf{fight-criminals}(m, t_{\text{graduate}}, w). \)

(11) Mei fought criminals after she graduated too.
    a. \( \lambda w. \exists t < t_{\text{graduate}} \textbf{fight-criminals}(m, t, w). \textbf{fight-criminals}(m, t_{\text{graduate}}, w). \)
    b. \( \lambda w. \exists t < t_{\text{graduate}} \textbf{fight-criminals}(m, t, w). \) \hspace{1cm} \text{DEL.}
       \[ \exists t < t_{\text{graduate}} \textbf{fight-criminals}(m, t, w) \land \textbf{fight-criminals}(m, t_{\text{graduate}}, w). \]
    c. \( \lambda w. \textbf{fight-criminals}(m, t_{\text{graduate}}, w). \)
It should not come as a surprise that the truth conditions expressed in (10c) correspond exactly to the second disjunct of the unavailable interpretation (3b): the standard approach has to prevent conversion from happening with *too* in order to account for the unavailability of (3b). On the other hand, there is no way to arrive at that interpretation from (11c), since the proposition expressed in the domain condition has been lost in the process of deletion. This result makes Klinedinst’s approach a better candidate to explain the contrast between *stop* and *too* than the standard approach. Klinedinst’s view directly predicts a split along the lines of the hard vs. soft distinction by exhausting the answers to a question that arises when considering Heim and Kratzer’s notation: do the propositions in the domain conditions also appear in the truth conditions? The answer is: when they do, the result is a soft trigger like *stop* and when they do not, the result is a hard trigger like *too*.

In this paper, we will refer to triggers like *stop* whose truth conditions entail their domain conditions as *entailing triggers*, and to triggers like *too* as *non-entailing triggers*. Klinedinst (2016) is not the first author to propose that one should distinguish between entailing and non-entailing triggers. This idea has received direct or indirect support both from the theoretical and the experimental literature.

2.2. Theoretical support

Two studies on the licensing of Negative Polarity Items (NPIs) have made use of the entailing vs. non-entailing distinction. Chierchia (2015: pp. 8–9) cites Gajewski (2011) as offering an analysis of the NPI-licensing contrast between plural and singular *the* illustrated in (12) along the lines of the entailment vs. non-entailing distinction. Gajewski models the plural and singular determiners as sharing an existential and a maximality presupposition, but models only singular *the* as also entailing the existence presuppositions. Gajewski then shows how the Downward-Entailing (DE) context characterizing the entailments of plural *the* gets neutralized by adding the presupposed content to the entailments of singular *the*. Since NPIs are assumed to be licensed only in Downward-Entailing (DE) contexts, only plural *the* licenses NPIs.

(12)  

- **Plural**: The clients that had **any** complaint were refunded.  
- **Singular**: *The client that had **any** complaint was refunded.*

Drawing on Gajewski’s proposal, Chierchia (2015) argues that such an entailing-vs-non-entailing approach can account for a contrast between English and Italian factives: while in English, certain emotive factives, but not cognitive factives, license NPIs (13), in Italian, no factive ever licenses NPIs, no matter whether emotive or cognitive. Chierchia assumes a cross-linguistically uniform semantics for factive verbs where only emotive factives introduce a DE context, thus accounting for their licensing of NPIs in English. He locates the contrast between English and Italian in their different complementizer systems (e.g., English *that* vs. Italian *che*).

In the same way that the DE context found in the (non-entailing) plural determiner is neutralized by the (entailing) singular determiner in Gajewski (2011), Chierchia proposes that English

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5Note that independently of Klinedinst’s analysis, one can still conceive of an entailing vs. non-entailing contrast as technically distinct from the soft vs. hard distinction.
and Italian complementizers both trigger the presupposition that the complement is true, but Italian complementizers additionally entail the truth of the complement. As a result, Chierchia shows, the DE context introduced by emotive factives get neutralized in Italian, but is left unaffected in English.

\[(13) \quad \text{a. Emotive: She was surprised that there was any food left} \]
\[(13) \quad \text{b. Cognitive: * She was aware that there was any food left} \]

Sudo (2012) already hints at Klinedinst’s later analysis of the hard vs. soft contrast in terms of an entailing vs. non-entailing split, but his main interest lies in the consequences of such a theoretical split on truth value judgments. He makes a crucial contribution to this question by identifying a linguistic environment where the contrast becomes evident. Sudo observes that embedding stop or again under non-monotone quantifiers such as Exactly \(N\) predicts different outcomes in otherwise equivalent contexts. Imagine two Linux computers and two Windows computers: the two Linux computers always crashed at launch last week, but the two Windows computers never crashed. This week, it was one of the two Linux computers and one of the two Windows computers that always crashed at launch. Sudo claims that the sentence (14) is a better description of the situation than the sentence (15), which he attributes to them having the semantic effect paraphrased in (b) for both examples.

\[(14) \quad \text{Exactly one computer stopped crashing this week.} \]
\[(14) \quad \text{a. } \lambda w : |\{x : \text{computer}(x, w) \land \exists t < t_0 \text{ crashed}(x, t, w)\}| \geq 1.\]
\[(14) \quad \text{b. } \approx \text{ The numbers of computers that went from crashing to not crashing is one} \]

\[(15) \quad \text{Exactly one computer crashed again this week.} \]
\[(15) \quad \text{a. } \lambda w : |\{x : \text{computer}(x, w) \land \exists t < t_0 \text{ crashed}(x, t, w)\}| \geq 1.\]
\[(15) \quad \text{b. } \approx \text{ The number of computers that just crashed is one} \]

Both stop and again introduce an existential presupposition about crashing last week. Because stop entails its presupposition, evaluating the truth of (14) consists only in counting the number of Linux computers that didn’t crash this week, since those are the ones that crashed last week to start with. Since only one of the Linux computers crashed this week, (14) is a true description of the situation. By contrast, again does not entail its presupposition and therefore considerations about last-week crashes do not factor in when evaluating the truth conditions of (15). Since more than one (namely two) of the four computers crashed this week (one in each group) (15) fails at giving an accurate description of the situation.

2.3. Experimental support

In a series of experiments testing sentences like (14) and (15) and controlling for various potential confounds, we found that English speakers’ judgments align with Sudo’s claims (Zehr
and Schwarz 2016). We describe the design of these experiments below, as we used the same design for the experiment discussed in this paper. Results from Cummins et al. (2012) and Amaral and Cummins (2015) also provide indirect support for the view that the presuppositions of a subset of expressions make optional contributions at the truth conditional level. These researchers presented their participants with brief dialogues in which one interlocutor affirms a presuppositional question while denying the presupposition. The dialogues were reported to be more natural for some triggers than for others. Djärv et al. (2017) adapted their paradigm to investigate cognitive vs. emotive factives (16) and found that their participants rated the dialogues as more natural when they involved emotives. They offer an analysis where speakers can accept an utterance while denying its presuppositions as long as its truth conditions are met: such an attitude is blocked for cognitive factives, which the authors analyze as entailing their presuppositions, but it is available for emotive factives, which are analyzed as non-entailing triggers (17).

(16) Q: Was Nadia aware of the Patriots won the Superbowl? A: Yes, although they didn’t.

(17) Yes [truth conditions], although [not presuppositions].

Experimental work on the processing of presuppositions provides us with further evidence that presuppositions come in different types. Domaneschi et al. (2014) invited their participants to memorize figures displayed on the screen for 6 seconds, listen to a recording of a short text, answer a question about the content of the text, and finally indicate which of sixteen figures displayed on the screen they were told to memorize at the beginning. The authors were interested in what happened between the two figure-display steps: the text contained five types of presupposition triggers, and five of the subsequent questions addressed their presuppositions. Having to keep in mind representations of figures for later recall constitutes a cognitive load that, the authors assumed, might unevenly impact the processing of presuppositions as opposed to the processing of entailments/truth conditions. Their participants’ answers indicate that they consistently endorsed the presuppositions of definite descriptions and factive verbs: after listening to the text—which contained the zambezi sharks and the guide explained that all the sharks are female—the participants reported that there were zambezi sharks in the aquarium and that all the sharks were female. By contrast, their participants much less readily endorsed the presuppositions of focus-sensitive particles and iterative triggers: the text contained even the zambezi sharks are taken out of their tanks and the re-introduction of a male shark into the tank, but only slightly more than half the participants reported that other animals were sometimes taken out of the tank and that a male shark had previously been introduced into the tank. Tiemann (2014) and Tiemann et al. (2015) randomly presented each of their participants with

6Importantly, judgments in control conditions indicate that our design successfully blocked problematic wide-scope readings of again which would yield the following interpretation for (15): this week again, one computer crashed.

7We give over-simplified truth conditions for happy: the crucial point is that they do not entail the domain conditions/presupposition.
one of two versions of a very short story: they both contained again and varied in whether they provided explicit support for its presupposition (18). An increase in reading times in the unsupported version indicates that participants were sensitive to the presence of a presupposition, and yet they show no sign of endorsement of the presupposition when probed for it (choosing to report that Linda received one pink lamp, not two).

(18) Last week, Linda bought Judith a pink lamp for a room.
   a. Two days ago, Judith received a pink lamp again. SUPPORT
   b. Two days ago, Linda received a pink lamp again. NEUTRAL

Both groups of authors analyze their results in light of a proposal by Glanzberg (2005) and claim that presupposition triggers pattern in two categories, differing in the optionality vs. necessity to endorse the truth of their presuppositions for successfully processing the sentences in which they appear. This paper proposes to analyze the entailing vs. non-entailing distinction in the same terms. The next section describes Glanzberg (2005)’s proposal and formulates a hypothesis linking it to the entailment properties of presupposition triggers.

3. The Removability/Independence Hypothesis

Glanzberg (2005) argues for a model of utterance interpretation where only a subset of presuppositions have crippling consequences when not supported by context. He illustrates such a situation with cleft constructions (19), which are known to trigger an existence presupposition (19a). Glanzberg proposes that determining the non-presuppositional contribution of cleft constructions necessitates resolving their presuppositional contribution, insofar as the existence presupposition binds a variable that features in the truth conditions (19b). Being unable to instantiate the variable (because the context clashes with the existence presupposition) results in being unable to process the truth conditions.

(19) Was it Shappa who fixed the car?
   a. Someone fixed the car
   b. $\lambda w : \exists x \text{ fixed}(C, x, w) \cdot x = S$.

On the other hand, Glanzberg proposes that determining the non-presuppositional contribution of too is independent from determining its presuppositional contribution, insofar as it involves no variable bound across the two domains (20b). As a result, even if the context establishes that the presupposition cannot hold (e.g., it has already been settled that Shappa did not fix anything—except possibly the phone) the truth conditions can still be felicitously processed.

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8 One might argue that clefts also carry exhaustivity presuppositions. We ignore this aspect here for the sake of the discussion.

9 (19b) exhibits non standard conventions for cross-domain anaphora: the $x$ appearing in the truth conditions is to be read as bound by the existential operator in the domain condition.

10 Our use of the expression truth conditions diverges from Glanzberg’s, as is our attempt at rendering the interpretation of presuppositional utterances in Heim and Kratzer (1998)’s notation style, since Glanzberg’s analyses are termed in a dynamic semantic framework.
(20) Did Shappa fix the phone too?
   a. Shappa fixed something else (e.g., the car)
   b. \( \lambda w : \exists x \neq P \text{fixed}(x, S, w) \). \( \text{fixed}(P, S, w) \).

Glanzberg’s approach provides a possible explanation for why a presupposition trigger would fall on one side or the other of Abusch’s split, and the view that (part of) the presuppositional and non-presuppositional contents of some triggers would be inextricably intertwined resonates with the view that some triggers entail their presuppositions. At this point, it is a good idea to reiterate our goal: explain Abusch’s observations about a contrast in presupposition suspension in terms of the Sudo/Klinedinst entailing vs. non-entailing distinction and explain the entailing vs. non-entailing distinction in terms of Glanzberg’s intertwined vs. independent contributions distinction. However, we will depart from the methods Glanzberg uses to probe how each trigger relates its presuppositional and non-presuppositional contributions. Instead, we will formulate the Removability/Independence Hypothesis, which we think makes clear and intuitive predictions about which triggers entail their presuppositions and which do not.

(21) **The Removability/Independence Hypothesis**

Presuppositions are NOT entailed if and only if removing triggering material yields (non-strictly) weaker interpretations of sentences

Let us use (22) to illustrate how this hypothesis predicts that the presupposition of *again* is not entailed. Removing *again* from (22a) results in (22b), which is a grammatical question whose interpretation is equivalent to (22a), minus the presupposition of the latter. According to the Removability/Independence Hypothesis, *again* does not entail its presupposition.

(22) a. Did Aki’s PC just crash again?
   (i) Presupposed: Aki’s PC crashed before
   (ii) Questioned content: Aki’s PC just crashed

b. Did Aki’s PC just crash again?
   (i) Presupposed: Aki’s PC crashed before
   (ii) Questioned content: Aki’s PC just crashed

On the other hand, removing *stop* from (23a) results in (23b). Let alone the crucial syntactic role of *stop* as a matrix verb, no minimal syntactic reconstruction of (23b) (e.g., substituting *is* for *did* or removing -ing along with *stop*) would succeed in conveying the contrasting aspect of *stop* and in yielding an interpretation weaker or equivalent to that of the initial sentence.

(23) a. Did Aki’s PC stop crashing?
   (i) Presupposed: Aki’s PC crashed before
   (ii) Questioned content: Aki’s PC does not crash now

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11Glanzberg starts from the observation that the flow of a discussion is differently impacted by unmet presuppositions from different triggers, but later refines his view on factive predicates. We will not pursue the same route, but note that results from Djärv et al. (2017), discussed earlier, hint at a contrast between emotive and cognitive factive predicates, which Glanzberg treats as equally intertwining their presuppositional and non-presuppositional contributions (after the necessary application of a complex repair strategy, see his Section V.4).
The two examples above should make clearer the intuition motivating the Removability/Independence Hypothesis: the semantic added value of some triggers, such as *again*, lies entirely in their presuppositions, so that their contribution is ultimately independent from the non-presuppositional content of the sentences in which they appear. Triggers like *stop* on the other hand, besides introducing presuppositions, make crucial contributions to the non-presuppositional content of the sentences in which they appear, in such a way that one cannot identify a presuppositional component next to a non-presuppositional component: the two come as one block. The hypothesis states that triggers of the former type define truth conditions that are independent from their presuppositions, while the presuppositions of triggers of the latter type are entangled in their truth conditions.

It should be noted that the hypothesis refers to triggering material rather than directly to triggers. Such a formulation is particularly adapted to cases like emotive vs. cognitive factives, for which designating factive predicates as triggers is standard, even though some authors propose to locate the source of the presupposition in the complementizer material (Chierchia 2015). We do not commit to a particular position here, but our formulation has the welcome property of categorizing the emotive factive *happy* as non-entailing and the cognitive factive *aware* as entailing, as can be seen in examples (24) and (25).

(24) a. Is Michelle happy that it’s raining?
   (i) Presupposed: it’s raining
   (ii) Questioned content: Michelle is happy (at the idea that it’s raining)

b. Is Michelle happy that it’s raining?
   (i) Presupposed: it’s raining
   (ii) Questioned content: Michelle is happy (at the idea that it’s raining)

(25) a. Is Michelle aware that it’s raining?
   (i) Presupposed: it’s raining
   (ii) Questioned content: Michelle believes that it’s raining

b. Is Michelle aware that it’s raining?
   (i) Presupposed: it’s raining
   (ii) Questioned content: Michelle believes that it’s raining

In contrast to Glanzberg (2005)’s proposal, the Removability/Independence Hypothesis gives a prominent role to the form of triggering material. It is conceivable that two expressions make the same presuppositional and non-presuppositional contributions, but differ in that one but not the other has identifiable (and removable) material introducing presuppositions. As a result, the Removability/Independence Hypothesis expects that there should exist pairs of sentences whose truth conditions only differ in whether they entail their presuppositions.
4. Experiment

We considered the three presuppositional expressions, *go again*, *go back* and *return*, which, paired with a destination, give rise to contextually equivalent effects: They all describe a visit while presupposing another previous visit. The two first expressions, however, differ from the last in a crucial way with respect to our hypothesis: they contain two clearly identifiable parts, one of which communicates about a visit (*go*) and one of which adds a presupposition of a *previous* visit (*again/back*). The contrast becomes evident when we apply the test introduced above: (26b) and (27b) define interpretations equivalent to (26a) and (27a) modulo the disappearance of their presuppositions; removing *return* from (28a) though results in the uninterpretable sentence (28b), where the main predicate is missing.\(^{12}\)

\[
\begin{align*}
(26) & \quad a. \text{ Did Dominique go to the shop again?} \\
& \quad (i) \text{ Presupposed: Dominique previously went to the shop} \\
& \quad (ii) \text{ Questioned content: Dominique went to the shop} \\
& \quad b. \text{ Did Dominique go to the shop again?} \\
& \quad (i) \text{ Presupposed: Dominique previously went to the shop} \\
& \quad (ii) \text{ Questioned content: Dominique went to the shop} \\
(27) & \quad a. \text{ Did Dominique go back to the shop?} \\
& \quad (i) \text{ Presupposed: Dominique previously went to the shop} \\
& \quad (ii) \text{ Questioned content: Dominique went to the shop} \\
& \quad b. \text{ Did Dominique go back to the shop?} \\
& \quad (i) \text{ Presupposed: Dominique previously went to the shop} \\
& \quad (ii) \text{ Questioned content: Dominique went to the shop} \\
(28) & \quad a. \text{ Did Dominique return to the shop?} \\
& \quad (i) \text{ Presupposed: Dominique previously went to the shop} \\
& \quad (ii) \text{ Questioned content: Dominique went to the shop} \\
& \quad b. \text{*Did Dominique return to the shop?} \\
& \quad (i) \text{ Presupposed: Dominique previously went to the shop} \\
& \quad (ii) \text{ Questioned content: ?? Dominique went to the shop}
\end{align*}
\]

Based on the Removability/Independence Hypothesis only *return* should entail its presuppositions. We tested this prediction by embedding the three triggers in an *Exactly N* environment, as discussed in Sudo (2012). As mentioned in Section 2.3, we successfully designed experiments using Sudo’s test in the past. The present experiment uses the same experimental design.

\(^{12}\)A weaker version of the hypothesis analyzing *return* as non-entailing by identifying *re-* as the sole contributor of the presupposition would have to sacrifice transparency, for *turn* cannot be associated with the truth conditions of *return*, and it would ultimately fail at giving a criterion to identify material contributing only presuppositions.
4.1. Design

Our experiment used the *Exactly N* test described in section 2.2 in a Covered Box design. Participants were informed that their task was to associate a sentence with one of two pictures on the screen, one fully visible and one whose content was partially hidden. The pictures in Figure 1 illustrate the type of pictures on the screen during critical trials for the sentences in (29). If participants access an entailing representation of the sentence (i), then they should report the visible picture on the left as a good match, since only one of the four characters is presented as going to the movies both before and on Wednesday. On the other hand, the visible picture on the left does not match a non-entailing representation (ii) since three of the four characters went to the movies on Wednesday, and participants should therefore select the covered picture on the right on the reasoning that the activity schedules obstructed by the black squares must represent a better match for the sentence.

(29)  a. Exactly one kid went to the Ore City movie theater again on Wednesday
    b. Exactly one kid went back to the Ore City movie theater on Wednesday
    c. Exactly one kid returned to the Ore City movie theater on Wednesday

(i) \[ |\{ x : movies(x, beforeW) \land movies(x, W) \}| = 1 \]
(ii) \[ |\{ x : movies(x, W) \}| = 1 \]

4.2. Materials and Participants

In addition to the triggers *again*, *back* and *return*, we included two other triggers to serve as baselines, *stop* and *also* (30), that we found in a series of previous studies to give rise to responses respectively consistent with an entailing representation and a non-entailing representation (Zehr and Schwarz 2016). We used Prolific.ac to recruit 150 participants, who we randomly assigned to one of the five triggers; they were paid £1.5 for an average duration of 12 minutes. Visual stimuli like that in Fig. 1 defined the *Test* condition: we code them as $ABAB \rightarrow AABA$ to represent the transition from each character’s Monday/Tuesday activities to their Wednesday activities (A standing for the activity mentioned in the *Exactly one sentence*).
The code for the visual stimuli in the Visible Control condition was $ABAB \rightarrow ABBB$;\(^{13}\) the code for the visual stimuli in the Covered Control condition was $ABAB \rightarrow ABAA$.\(^{14}\) Each participant saw 36 items, corresponding to 12 repetitions of each condition. We used a Latin-square design to create 15 groups so that each of the 36 items would appear in all three conditions for all five triggers but each participant would see each item for only one condition. The items were presented in random order.

(30) a. Exactly one kid stopped going to the Ore City movie theater on Wednesday
   b. Exactly one kid went to the Ore City movie theater again on Wednesday

Each trial consisted of a sequence corresponding to the following script. The two visible (left) and covered (right) pictures appear centered on the screen with only the Monday and Tuesday activities visible. An audio recording of a context sentence like that in (31) automatically plays back while participants look at the screen. The Wednesday slots appears at the end of the playback (covered by a black squares for the picture on the right) and an audio recording of one test sentence like the ones in (30) automatically starts playing back. From this point on, participants can select the visible left picture by pressing the $F$ key on their keyboard, or the covered right picture by pressing $J$. The screen is cleared and the next trial starts after one of these two keys is pressed.

(31) This week, these kids went to Ore City for the first time. At the beginning of the week, some kids went to the Ore City pool, and some people went to the Ore City movie theater.

The sentences were recorded by a native speaker of English who was instructed to produce the intonation contour on the also sentences in such a way that it conveyed an association with on Wednesday.\(^{15}\)

4.3. Predictions

Also and stop served as baselines. We reported in Zehr and Schwarz (2016) that also sentences yielded covered image choices and stop sentences visible image choices in the Test condition, as consistent with the predictions made by a view where stop, but not also, entails its presuppositions. We saw at the beginning of this section how the Removability/Independence Hypothesis analyzes return as an entailing trigger and back and again as non-entailing triggers. It thus predicts that return patterns with stop in eliciting visible picture choices in the Test condition, and that back and again pattern with also in eliciting covered picture choices.

\(^{13}\)Note that in the Visible Control condition two of the four characters engage in the mentioned activity on Monday and Tuesday, thus controlling for potential wide-scope readings of also and again (see footnote 6).

\(^{14}\)The codes defining the condition for stop were: $ABBA \rightarrow BBBA$ (Test), $ABBA \rightarrow BAAA$ (Visible Control) and $ABBA \rightarrow BABB$ (Covered Control).

\(^{15}\)An archived version of the experiment can be found at http://spellout.net/ibexexps/SchwarzLabArchive/PsEntStopReturnBackAgain/experiment.html.
4.4. Results

Accuracy on controls was good overall, with the exception of a few participants in each group. We excluded from our analyses any participant who chose more than 25% visible or covered pictures in the Control Covered or Control Visible conditions respectively,\(^{16}\) for a final set of 128 accurate participants out of 150. The bar plot in Figure 2 reports the mean choice of visible pictures for each trigger in each condition for the accurate participants.

We used the R software (version 3.3.3) and the function lmer (version 1.1 – 13) to fit a logistic regression model on the data, predicting choices of visible pictures as a function of two factors (baselines first): Condition (Test vs. Control Covered vs. Control Visible) and Trigger (Also vs. Return vs. Again vs. Back vs. Stop). The model tested both for simple effects and interactions between the two factors and included a random intercept per item and per participant as well as a random slope per participant per condition. Following the recommendations of Bates et al. (2015) we started from a maximal random structure and simplified it until we reached the simplest converging model that would not significantly differ in goodness of fit (as reported by ANOVA comparisons of models). Our final model forced a zero correlation in the random slope per participant per condition.

The model reports no significant contrast between Also-Test on the one hand and Return-Test (\(\beta = 1.0181; SE = 1.285; p = 0.428\)) and Again-Test (\(\beta = 1.8218; SE = 1.338; p = 0.173\)) on the other hand. Back-Test, however, significantly increased the likelihood of a visible picture observation (\(\beta = 3.539; SE = 1.349; p < 0.01\)) and so did Stop-Test (\(\beta = 11.2195; SE = 1.849; p < 0.01\)). Participants were reportedly more likely to choose the visible picture in Also-Control Covered than in Also-Test (\(\beta = 2.9478; SE = 1.158; p < 0.05\)). Note that this effect is opposite of the descriptive summary in Fig. 2. Looking at individual profiles reveals that 9

\(^{16}\)Distributed across trigger groups as follows: Also: -7 ppts; Return: -1; Back: -3; Again: -4; Stop: -7.
out of the 24 Also participants selected the visible picture at least once (and only once for 7 of them) in the Control Covered condition contra only 6 in the Test condition (4 of them were also Control Covered acceptants). The descriptive flip in the bar plot seems to be entirely due to one participant who selected the visible picture on more than half the Test trials, whereas no participant did so on more than a quarter the Control Covered trials (which follows from our filtering for accuracy). Two significant interactions are noteworthy: Also vs. Again × Test vs. Control Covered ($\beta = -2.8881; SE = 1.4239; p < 0.05$) and Also vs. Back × Test vs. Control Covered ($\beta = -3.4490; SE = 1.3824; p < 0.05$). Looking at individual profiles is again informative: 2 out of the 26 Again participants always chose the visible picture in the Test condition (while no Also participant did) and 9 out of the 27 Back participants chose the visible picture more than half the time in the Test condition (only one Also participant did).

5. Discussion

The results clearly contradict the predictions of the Removability/Independence Hypothesis: return did not pattern with the entailing trigger stop. Instead, it behaved remarkably similarly to the non-entailing trigger also, as did again and back. At the same time, it is important to note that these results replicate the contrast between stop and also that we had found in previous studies, which can be explained by a contrast in entailment. The also participants rejected visible pictures that depicted more than one character engaging in the mentioned activity on Wednesday (Test and Control Covered conditions) regardless of their activities on Monday and Tuesday. The entailed presupposition of stop, however, factored into the truth conditions of the exactly one sentences, so participants considered the Monday and Tuesday activities when counting characters. As a result, they accepted visible pictures that depicted more than one character not engaging in the mentioned activity on Wednesday, as long as only one of them had previously engaged in it on Monday and Tuesday.

Though the Stop participants clearly contrasted with the others in overwhelmingly choosing the visible picture in the Test condition, a small subset of the latter also consistently chose the visible picture in the Test condition. This is not straightforwardly expected if also, again, back and return do not entail their presuppositions, as suggested by the majority of participants who rejected the covered picture. In section 2.1 we followed Klinedinst (2016) in introducing the operation of presupposition deletion as a one-step alternative to the two-step operation of presupposition conversion commonly known as local accommodation. The two operations are not mutually exclusive, and we analyze (rare) acceptance of the visible picture in the Test condition as resulting from local accommodation of the presuppositions of also, again, back and return. As a result of this operation, these triggers yield interpretations where the presupposition becomes part of the truth conditions, as is the case lexically for stop, and those participants who applied local accommodation accordingly chose the visible picture in the Test condition, where only one character engaged in the mentioned activity both on Wednesday and on Monday and Tuesday. The question remains as to what led some of our participants to access local accommodation interpretations of our sentences, and more particularly why such interpretations were more readily available for back (and, to a lesser extent, for again) than for also and return. We have to leave this question for future investigations.17

17Focusing presupposition triggers could favor local accommodation readings, and one could tentatively explain
The Removability/Independence Hypothesis offered an explanatory approach by predicting which triggers entail and which do not entail their presuppositions. That *return* patterned with *also* rather than *stop* strikingly invalidates the hypothesis and leaves us in need of an account for why, out of the five triggers we tested, only *stop* seemed to always factor its presupposition into the process of picture selection. Tonhauser et al. (2013) conducted a series of three experiments showing that prosody influences whether factive presuppositions project outside of entailment-canceling environments, and offered an analysis where prosody serves as a proxy for the contextual information structure, which ultimately determines whether a presupposition is even triggered to start with. Following an analysis of our results along these lines, one would expect our *stop* recordings to manifest specific prosodic cues that distinguish them from our other recordings. We conducted post-hoc analyses focusing on pitch. Our hypothesis was that a high pitch on a trigger draws attention to its contributions so that its presuppositions end up part of the truth conditions of the sentence. The resulting prediction was that higher pitches should increase the likelihood of a visible picture choice (because what happened on Monday and Tuesday becomes more salient). We measured the mean relative pitches on each trigger in our recordings and found a higher average pitch for *back* than for *again*, as consistent with the observation that *back* yielded more visible picture choices than *again*. The mean pitch for *stop* was even higher, but so was the mean pitch for *return* (and to a lesser extent the mean pitch of *also*) which, however, yielded fewer visible picture than both *back* and *again*. Therefore, pitch alone clearly cannot explain our observations, but it could account for some variation in our data (see footnote 17), in line with Djarv and Bacovcin (2017), who conducted an experiment as a response to Tonhauser et al. (2013) and argued that prosody is a real but a small factor influencing the status of presuppositions.

Abrusán (2016) offers an account of presuppositions where temporal reference plays a central role. She proposes a typology where triggers can differ in whether they refer to a single or to multiple reference times. The presuppositions of triggers referring to a single reference time have to be considered jointly with non-presuppositional content because they necessarily refer to the same reference time; other triggers introduce a second reference time in their presuppositions and thus make two distinct, independent contributions. It seems that *stop* refers to a unique time span: stopping consists in reaching an end point on a temporal scale. By contrast, *return*, (go) *back*, (go) *again* and also (go on Wednesday) all refer to a distinct past reference time, and impose no continuity relation with their main reference time. As a result, it would be impossible to ignore the presupposition of *stop* when making a decision about how many characters satisfy the description, whereas it would be possible to focus on the salient event of going in the other cases. Data from a pilot and from a new experiment, however, suggest that *continue*, which is a prototypical case of a continuous (and thus single) reference time as in the case of *stop*, patterns along with non-entailing triggers in the *exactly one* test.

Closely related to the idea of (dis)continuity is an explanation in terms of contrastivity. As alert readers may already have noticed, *stop* stands out in being the only trigger that involves a mismatch between the Monday and Tuesday activities and the Wednesday activity. A natural explanation for this behavior could be that the higher frequency of local accommodation for *again* and *back* under the assumption that moving them to focus position was easier than moving *also* (which came with a particular association contour in our recordings) and *return* (which is a main predicate). See below for further discussion on the role of prosody in our experiment.
explanation for our results would be that this property of stop led the participants in the corresponding group to pay attention to the Monday and Tuesday slots throughout the task, while the participants in the other trigger groups could have decided to exclusively rely on the Wednesday slots to make their decisions. Such a task-and-trigger-specific strategy is highly problematic, since it would undermine our ability to diagnose the entailing properties of a trigger through the exactly one design. Initial results coming from a follow-up experiment including a condition where the Monday and Tuesday slots in the visible picture do not even satisfy an existential presupposition reveal that many participants indeed do not pay attention to it (i.e., they choose the visible picture despite no character satisfying the presupposition). But they also reveal clearly different profiles for stop and again participants: while no participant who paid attention to Monday and Tuesday ever chose the covered picture for Stop-Test, some did for Again-Test. This suggests that even when Again participants are actively looking at Monday and Tuesday (as reflected by rejection of pictures not satisfying the existential presupposition) some of them still are unhappy with pictures in which more than one character engages in the mentioned activity on Wednesday, even though only one also engaged in it on Monday and Tuesday. Moreover, the follow-up experiment also included the triggers no longer and not anymore which share the contrastivity of stop, and yet they did not show a pattern specific of entailing triggers. Our current project is to investigate the possibility that contrastivity might interact with continuity in impacting the truth conditional contributions of presuppositions.

6. Conclusion

By formulating the Removability/Independence Hypothesis, we explored a possible explanatory account of the hard vs. soft split. In doing so, we combined the Sudo/Klinedinst entailing vs. non-entailing account of the contrast in local contribution of soft vs. hard presuppositions, with an approach inspired by Glanzberg, whereby the fulfillment of some presuppositions is a necessary condition to arrive at interpretable utterances. In contrast to competing explanatory approaches, this hypothesis has the particularity of giving a formal, rather than conceptual, identification criterion for hard vs. soft triggers. Consistently, it sorts the presuppositional expressions return and go back into opposite sides of the split, even though they express nearly equivalent concepts. The results of our experiment allow us to rule out this formal hypothesis, and thus indirectly provide support for conceptual approaches. The question of what determines the typological properties of a presupposition trigger has important repercussions. Perhaps the most important one concerns language acquisition: if each presupposition trigger belongs either to the hard or to the soft category, how do children eventually figure out which box a specific expression should go into? The question appears even more intricate in light of Dudley’s (2017) observation that cues that an expression is presuppositional are very scarce in children corpora. Identifying a conceptual source for the split would help shed light on how children arrive at (or maybe start with) a mature representation of presupposition triggers.

18Note that, by design, picture selection would be unaffected whether the Monday and Tuesday slots were ignored in the control conditions.

19Though formal considerations might still be in order when accounting for the higher rate of readings of back in which the presupposition makes a local contribution.
References


Abstract. Enough-too-constructions (E/T constructions) have an implicative reading: e.g., Mary was clever enough to leave early yesterday entails Mary left early yesterday. I argue that this implicative reading is not due to the lexical semantics proper of enough/too, but due to its bi-clausal structure (e.g., the above-mentioned example is analyzed as Mary left early yesterday because she was clever enough). I analyze enough and too simply as degree modifiers that involve a comparison: enough means reaching the lower bound of an interval, while too means exceeding the upper bound of an interval. Then inspired by Schulz (2011), Baglini and Francez (2015), and Nadathur (2016), I relate the semantics of E/T constructions to causal dependence: due to some sufficiency/excess, the infinitival complement clause in E/T constructions is episodically or generically (depending on its aspect being perfective or imperfective) true/false. I also argue that this infinitive has its tense and aspect marked on the main predicate of sentences, resulting in the seeming correlation between aspect and implication in languages that overtly make a distinction between perfective and imperfective aspects (e.g., French).

Keywords: enough, too, comparatives, causal dependence, necessary (but not necessarily sufficient) causes, sufficient (but not necessarily necessary) causes, infinitives, implicatives.

1. Introduction

This paper analyzes the semantics of enough, too, and enough-too-constructions (E/T constructions). E/T constructions contain an infinitival complement, and it has been noticed that they have implicative inferences and license so-called actuality entailment (or realis reading) for their infinitival complement (Karttunen 1971). For example, sentence (1a) entails that its complement clause Mary left early is true, while sentence (1b) entails that its complement clause Bill stayed awake is false (i.e., the negation of this complement clause is true).

(1) E/T constructions and their actuality entailment:
   a. Mary was clever enough to leave early.  \( \rightarrow \) Mary left early.
   b. Bill was too tired to stay awake. \( \rightarrow \) Bill didn’t stay awake.

The implicative reading of these sentences is reminiscent of real implicatives (e.g., manage, see Karttunen 1971), but the contrast between (2a) and (2b) seems to suggest defeasibility and calls for a pragmatic account for the cases involving enough/too.

(2) a. Sue managed to finish homework, # but eventually, she failed to finish homework.
   b. (i) John was tough \textbf{enough} to win tennis matches, but yesterday, he lost.
      (ii) John was \textbf{too} proud to apologize, but Tom made him apologize anyway.

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1I thank my informants, Alan Bale, Aron Hirsch, Tom Leu, Elizabeth Smith, the audience at the Université du Québec à Montréal (UQAM), the Semantics Reading Group at McGill University, and the reviewers of Sinn und Bedeutung 22 for discussions or feedback. Special thanks to Prerna Nadathur! Errors are mine.

2However, I will show that not all enough/too-sentences containing an infinitive are genuine E/T constructions.
However, a further complication has been noted by Hacquard (2005, 2006): in French, this defeasibility correlates with the use of perfective/imperfective aspect, as shown in (3). When French *assez*-*trop*-sentences are in perfective aspect (i.e., *passé composé*), their actuality entailment is not cancelable (see (3a)), which is in contrast with the case of those *assez-trop*-sentences in imperfective aspect (i.e., *imparfait*) (see (3b)).

(3) French *assez*-sentences in perfective vs. imperfective aspect:
   a. Jean a été assez rapide pour s’enfuir, mais il ne s’est pas enfui.
      John was-<suf>-enough quick to escape, but he didn’t escape.
      ‘John was quick enough to escape, but he didn’t escape.’
   b. Jean était assez rapide pour s’enfuir, mais il ne s’est pas enfui.
      John was-*ipf* enough quick to escape but he didn’t-<suf> escape
      ‘John was quick enough to escape, but he didn’t escape.’

Nevertheless, as noted by Hacquard (2006) and Nadathur (2017), French *assez* and *trop* are still questionable as real implicatives, since the implication of real implicatives (e.g., *réussir*) can never be cancelled, no matter whether they are in perfective or imperfective aspect (see (4)).

(4) a. Juno a réussi à gagner la course, mais elle n’a pas gagné.
   Juno succeed-*pfv* to win the race, but she didn’t-*pfv* win
   ‘Juno managed to win the race, but she didn’t win.’
   b. Juno réussissait à gagner la course, mais elle n’a jamais gagné.
   Juno succeed-*ipf* to win the race, but she didn’t-*pfv* never-<suf> win
   ‘Juno managed to win the race, but she never won.’

Thus we need to explain (i) why sentences in (1) have an implicative reading and (ii) why there seems a correlation between aspect and implication in French.

Previously, this implicative reading has been attributed to a two-way entailment between sufficiency/excess and the event described by the infinitival complement of E/T constructions. In particular, Hacquard (2005, 2006) has proposed that *enough* and *too* are real implicatives and their semantics already contains hidden two-way entailment, and it is the use of a genericity operator (which is overtly reflected by the use of imperfective aspect in French) that is responsible for the non-implicative readings (see Bhatt 1999). However, according to Nadathur (2017), *enough* and *too* are themselves not real implicatives: they only contain hidden modals to express some capacity, which makes them a necessary condition, and an actuality entailment arises due to (i) the use of a sufficiency operator that turns them into a sufficient condition and (ii) ‘actualistic’ aspectual coercion under perfective aspect (see Homer 2011).

In Section 2, I use a set of data to show that not all *enough-*/*too*-sentences contain an infinitival complement, and thus, the lexical semantics of *enough/too* should be much simpler, involving neither hidden two-way entailment nor hidden modals. In Section 3, with an interval-based framework for gradable adjectives (see Zhang and Ling 2015, 2017a,b), I analyze *enough* and *too* as degree modifiers: *enough* means reaching the lower bound of an interval (i.e., *not less (than)*), while *too* means exceeding the upper bound of an interval (i.e., *more (than)*).
Section 4 shows that not all enough-/too-sentences containing an infinitive are genuine E/T constructions. Genuine E/T constructions are actually bi-clausal, and causal dependence is involved in their interpretation (see (5)): the meaning of sufficiency brought by enough provides a necessary but not necessarily sufficient (i.e., necessary but potentially insufficient) cause for its complement clause to be true, while the meaning of excess brought by too provides a sufficient but not necessarily necessary (i.e., sufficient but potentially unnecessary) cause for its complement clause to be false. Based on Wurmbrand (2014), Section 5 shows that due to the restructuring-like syntax of genuine E/T constructions, the semantic tense and aspect of their infinitival complement are marked on the main predicate, resulting in the seeming correlation between aspect (or rather episodicity) and implication in languages like French.

(5) The interpretation of genuine bi-clausal E/T constructions involves causal dependence:

a. \[[ (1a) ] \] = Mary left early because she was clever enough. \(\leadsto\) Mary left early.

b. \[[ (1b) ] \] = Bill didn’t stay awake because he was too tired. \(\leadsto\) B. didn’t stay awake.

2. Challenges to previous accounts

Focusing on the actuality entailment for the infinitive in E/T constructions, previous studies (including Meier 2003; Hacquard 2005, 2006; Nadathur 2017) have proposed that (i) this implicative reading is essentially due to a two-way entailment between sufficiency/excess and the event described by the infinitival complement, and that (ii) either the lexical semantics of enough/too contains already hidden two-way entailment (Hacquard 2005, 2006), or it contains hidden modals that partially contribute to the expression of two-way entailment (Meier 2003; Nadathur 2017). Here I use naturally occurring examples to show that infinitives are not necessarily present in enough/too-sentences. Therefore, those previous accounts all under-generate.

According to Hacquard (2005, 2006), sentence (6) presupposes that there is a unique degree of quickness which is a necessary and sufficient condition for John’s escape and asserts that John meets this condition. Thus, Hacquard (2006) proposes (7a) and (7b) as the lexical entries of enough and too. Their presuppositional requirement is underlined: there is a unique degree \( d \) such that in all possible worlds \( w' \) accessible from the actual world \( w \), sentence \( Q \) is true (for enough) or false (for too) iff \( x \) reaches the degree \( d \) on the scale \( P \) in world \( w' \). The assertion is that \( x \) reaches this unique degree \( d \) on the scale \( P \) in the actual world \( w \).

(6) Jean a été assez rapide pour s’enfuir.
John was-FFV enough quick to escape
‘John was quick enough to escape.’ (French enough-construction in perfective aspect)

a. Presupposition: there is a degree of quickness sufficient & necessary for his escape.
b. Assertion: John had the degree of quickness sufficient & necessary for his escape.

(7) a. \[[ enough ] \] \( ^w \) \( \overset{\text{def}}{=} LP_{\langle d, (e, st) \rangle} \cdot \lambda Q_{\langle st \rangle} \cdot \lambda x_e^P \{ \forall w' \in \text{Acc}(w). Q(w') \leftrightarrow P(d)(x)(w') \}(x)(w) \)

b. \[[ too ] \] \( ^w \) \( \overset{\text{def}}{=} LP_{\langle d, (e, st) \rangle} \cdot \lambda Q_{\langle st \rangle} \cdot \lambda x_e^P \{ \forall w' \in \text{Acc}(w). \neg Q(w') \leftrightarrow P(d)(x)(w') \}(x)(w) \)

\( (P: \) gradable adjective; \( Q: \) the infinitival complement clause; \( x: \) subject.\)
Under this account, as far as the actual world $w$ is accessible to itself, the two-way entailment in the lexical entries of *enough* and *too* makes them **real implicatives**.

To account for the non-implicative reading of *enough/-too-* sentences in imperfective, Hacquard (2006) adopts Bhatt (1999)’s **genericity operator** (see (8)), which was originally developed to explain the correlation between aspect and implication for French ability modal *pouvoir.*

The use of this genericity operator is overtly reflected by the use of imperfective aspect in languages like French. As shown in (9), with the use of $\text{gen}$, the set of accessible worlds is further restricted (by an overt or contextually-provided $p$), and the consequence is that the actual world is no longer necessarily one of those highly idealized ones where reaching a unique degree of quickness guarantees John’s escape.

(8) $[[\text{gen}]]^w \overset{\text{def}}{=} \lambda p(\langle sl \rangle).\lambda q(\langle sl \rangle).\forall w'[w' \in \text{Acc}(w) \land p(w') \rightarrow q(w')]$ ($p$ restricts the set of $w'$.)

(9) Jean était assez rapide pour s’enfuir
John was-*ipfv* enough quick to escape
‘J. was quick enough to escape.’ (French *enough*-construction in imperfective aspect)

$\text{gen}(w)[\lambda w. w \text{ was relevant}][\lambda w. \text{John had the sufficient/necessary quickness to escape in } w]$}

In all **relevant** worlds, John had the quickness to escape.

However, real implicatives like *réussir* are immune to the actuality-entailment-cancelling effects of the genericity operator (see (4)), because even in imperfective sentences, their implicative reading is not cancelable. This poses a challenge for Hacquard (2005, 2006).

Alternatively, Bierwisch (1987), Meier (2003), von Stechow et al. (2004), Schwarzschild (2008), Marques (2012), and Nadathur (2017) take the view that *enough* and *too* are **intrinsically non-implicative**, i.e., their lexical semantics does not contain hidden two-way entailment. Nevertheless, *enough* and *too* are analyzed in terms of a comparison involving a hidden modal.

As shown in (10) and (11) (see von Stechow et al. 2004 and Nadathur 2017), *enough/too* relates a predicate $Q$ (typically provided by the infinitival complement), a gradable adjective $P$, and an individual $x$. E.g., *Jo was fast enough to escape* means that in any **world** $w'$ where Jo escaped, her speed was not higher than her actual speed in world $w$; *Jo was too slow to escape* means that in at **least one world** $w'$ where Jo escaped, her speed was higher than her actual speed.

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3Bhatt (1999) has pointed out that there is also a correlation between aspect and implication for French ability modal *pouvoir*, as illustrated by the contrast in (i). Bhatt (1999) proposes to analyze *pouvoir* as a real implicative like English *manage*: French *pouvoir* asserts the realization of its complement clause and conveys the conventional implicature that some effort contributes to the realization of the complement clause. Then Bhatt (1999) uses a genericity operator to derive the non-implicative reading of *pouvoir*-sentences in imperfective.

(i) a. Jean a pu soulever cette table, # mais il ne l’a pas soulevée.
John **could-pfv** lift this table, # but he didn’t-pfv lift
‘John was able to lift this table, # but he didn’t lift it.’

b. Jean pouvait soulever cette table, mais il ne l’a pas soulevée.
John **could-pfv** lift this table but he didn’t-pfv lift
‘John was able to lift this table, but he didn’t lift it.’
(10) a. \([\text{enough}]^w \overset{\text{def}}{=} \lambda Q(e,⟨st⟩).\lambda P(d,⟨e,st⟩).\lambda xe.\{d : \forall w' \in \text{Acc}(w)[Q(x)(w') \rightarrow P(d)(x)(w')]\} \subseteq \{d : P(d)(x)(w')\}

b. \([\text{too}]^w \overset{\text{def}}{=} \lambda Q(e,⟨st⟩).\lambda P(d,⟨e,st⟩).\lambda xe.\{d : \exists w' \in \text{Acc}(w)[Q(x)(w') \land P(d)(x)(w')]\} \subseteq \{d : P(d)(x)(w')\}

(11) a. \([\text{fast}]^w \overset{\text{def}}{=} \lambda dx,\lambda xe.\text{speed}(x)(w) \geq d\quad \{d : \text{fast}(d)(x)(w)] = [0, x's \text{ max. speed}\}

b. \([\text{slow}]^w \overset{\text{def}}{=} \lambda dx,\lambda xe.\text{speed}(x)(w) < d\quad \{d : \text{slow}(d)(x)(w)] = (x's \text{ max. speed, } +\infty)\}

Based on these lexical entries, Nadathur (2017) proposes an account within Nadathur (2016)’s framework of causal dependence (see also Schulz 2011, Baglini and Francez 2015). According to this framework, as shown in (12), actuality entailment \(X\) holds if (i) there is a necessary and sufficient causing factor \(A\) and (ii) \(A\) holds.

(12) Given an implicative \(I\) and a complement proposition \(X\), then \(I(X)\)

a. presupposes the existence of a causing factor/event \(A\) so that:
   i. \(A\) is causally necessary for \(X\),
   ii. \(A\) is causally sufficient for \(X\);

b. asserts that \(A\) holds in the world of evaluation. (i.e., the actualization of \(A\).)

Thus, as illustrated in (13), under Nadathur (2017)’s account, the actualization of Jo’s escape depends on (i) her speed in the actual world \(w\) (here written as ‘Jo’s maximum speed in \(w’\) being a sufficient and necessary factor for Jo’s escape and (ii) Jo’s actually being that fast.

Essentially, the lexical semantics of enough makes Jo’s speed in the actual world a necessary factor, while the use of a causal sufficiency operator \(\succ_{\text{caus}}\) further makes it a sufficient factor. Notice that the use of this causal sufficiency operator \(\succ_{\text{caus}}\) requires that (i) the flavor of the modal involved in the lexical semantics of enough be circumstantial and that (ii) the gradable adjective represent an exercisable capacity. Finally, the use of perfective aspect (which is overtly marked in French) guarantees Jo’s actually being that fast (see Homer 2011). Therefore, we get the actuality entailment that Jo escaped.

(13) Jo was fast enough to escape.

a. Jo’s maximum speed is a necessary condition for her escape:
   i. Presumption: \(\exists d_{\text{nec}} : \forall w' \in \text{Acc}(w)[\text{Jo’s speed in } w' < d_{\text{nec}} \rightarrow \neg \text{escape(Jo)}(w')]\)
   ii. Assertion: Jo’s max. speed in \(w \geq d_{\text{nec}}\)

b. Jo’s maximum speed is a sufficient condition for her escape:
   With (i) a circumstantial modal and (ii) a gradable adjective representing an exercisable capacity, the sentence backgrounds:
   \(\forall w' \in \text{Acc}(w)[\text{fast}(d_{\text{nec}})(\text{Jo})(w') \succ_{\text{caus}} \text{escape(Jo)}(w')]\)

Nadathur (2017)’s account is similar to the account of Hacquard (2005, 2006) in that the implicative reading results from a two-way entailment. However, here this two-way entailment is not entirely due to the lexical semantics of enough/too, but partially due to the use of the operator \(\succ_{\text{caus}}\). This brings some conceptual problems.
First, according to the framework (12), it has to be the same factor (here $A$) that serves both a necessary and a sufficient condition for $X$. However, for sentence (13), Jo’s being $d_{rec}$-fast is by itself a necessary condition for Jo’s escape, while it is the use of a sufficiency operator that turns this into a sufficient condition. Thus, it is questionable whether the necessary and the sufficient conditions are exactly the same here.\(^4\)

Moreover, in the framework (12), implicative $I$ is distinct from causing factor $A$. However, under Nadathur (2017)’s account, it remains unclear which element in E/T constructions contributes to the expression of implicative $I$. If it is the semantics of $enough/too$, then how can $enough/too$ be involved in the expression of both the implicative and the causing factor? What would be the consequences in terms of compositionality? Further explanation is needed here.\(^5\)

In fact, actuality entailment does not necessarily involve causally necessary and sufficient factors, or even causal dependence at all (i.e., actuality entailment might not even involve (i) causally necessary but insufficient or (ii) causally sufficient but unnecessary factors). For example, sentence (14) means that $John$ made a boat with oak and entails that $John$ made a boat, but no causal dependence is involved here. Thus, any account for the actuality entailment of E/T constructions needs to explain the exact source and the exact nature of their actuality entailment. The framework of (12), which only addresses causally necessary and sufficient factors, might turn out to be irrelevant.

\begin{equation}
(14) \quad John \text{ used oak to make a boat.} \quad \leadsto \quad John \text{ made a boat.}
\end{equation}

Empirically, by including hidden two-way entailment or modals in the lexical semantics of $enough/too$, the accounts of both Hacquard (2005, 2006) and Nadathur (2017) rely on the presence of infinitival complements for these degree adverbs and thus suffer from under-generation. Naturally occurring examples from the Corpus of Contemporary American English (COCA, Davies 2008) show that infinitival complements are not necessary in the use of $enough$ and $too$.

\begin{equation}
(15) \quad \begin{align*}
a. & \quad \text{The double-bedded room seemed luxury } enough \text{ compared to the farm house.} \quad (Fantasy & \text{ Science Fiction, 1995}) \\
b. & \quad \text{The rest of us do count for something, but not } enough \text{ compared with him, since Walter’s absence makes us all invisible in our parents’ eyes and in our own.} \quad (The \ Hudson Review, 2009) \\
c. & \quad \text{He was young } enough \text{ and strong } enough \text{ compared to H.} \quad (CBS: 48 Hours, 2011) \\
d. & \quad \text{Erdogan and his party won a mere 258 seats, not } enough \text{ even for a parliamentary majority.} \quad (National Review, 2015) \\
e. & \quad \text{She uses a 2013 Dell laptop: new by government standards, but clunky } enough \text{ compared with the cutting-edge devices of her former life.} \quad (New York Times, 2015)
\end{align*}
\end{equation}

\(^4\)Notice also that the use of this sufficiency operator also brings additional stipulations (i.e., its requirements for modal flavor and adjective type), which makes this operator rather \textit{ad hoc}. However, without these \textit{ad hoc} stipulations, presumably, this operator would turn any necessary condition into a necessary and sufficient one.

\(^5\)It seems that real implicatives like \textit{manage} do not play this kind of dual role. According to the analysis of \textit{manage} by Baglini and Francez (2015), \textit{manage} invokes the existence of some necessary but insufficient factors, but does not express this kind of factors itself.
3. Proposal: the semantics of enough and too

Here I propose that enough and too are simply degree modifiers that involve a comparison with a certain interval on a scale. Essentially, enough means reaching the lower bound of an interval, while too means exceeding the upper bound of an interval (see Figure 1).

To formally implement this proposal, I adopt Zhang and Ling (2015, 2017a,b)’s interval-arithmetic-based framework for the semantics of gradable adjectives and comparatives. This framework is motivated to allow for a generalized comparison on a scale and based on two assumptions. First, a comparative (e.g., 5:00 is 1 hour earlier than 6:00) means a relation among three degree-related items: two positions on a scale — comparative subject and comparative standard (e.g., the positions marking 5:00 and 6:00 on the temporal scale) — and the distance between them — differential (e.g., here 1 hour). Second, we adopt a generalized view for positions on a scale and represent them as intervals. An interval is a range of degrees so that it marks a position in a not-so-precise way. Thus it is a convex set of degrees: e.g., \( \{x | a \leq x \leq b\} \), which means a position ranging from \( a \) to \( b \) and can also be written as \( [a,b] \).

Operations on two intervals result in the largest possible range (Moore 1979). As shown in (17), a generalized comparison can be characterized in terms of interval subtraction: subtracting the interval representing the comparative standard from the interval representing the comparative subject results in a third interval — the differential.

\[
\begin{align*}
\text{Interval subtraction:} & \quad \text{comparative subject} - \text{comparative standard} = \text{differential} \\
& \quad [y_1,y_2] - [x_1,x_2] = [y_1-x_2,y_2-x_1] \\
E.g., \quad [7,8] - [2,3] &= [4,6] \\
4 \text{ and } 6 \text{ are the min. and max. distances between the positions } [7,8] \text{ and } [2,3] \text{ respectively.}
\end{align*}
\]

\[\text{A convex totally ordered set is a totally ordered set } P \text{ such that for any elements } a \text{ and } b \text{ in the set, if } a \leq b, \text{ then any element } x \text{ such that } a \leq x \leq b \text{ is also in the set. Evidently, sets such as } \{x | x \leq 5 \lor x > 8\} \text{ are not convex.}\]

(16) a. The costs of this technology were at that time too high compared to diskettes for such applications. (IBM Journal of Research and Development, 1998)

b. (...) The U.S. petroleum industry found itself shutting in an extraordinary portion of its domestic production capacity, which was too high-priced compared to foreign-sourced oil. (Journal of International Affairs, 1999)

c. Perhaps it was too expensive compared to similar items. (Reference & User Services Quarterly, 2012/2013)

d. They appeared much too small compared with the actual Sun (...). (space.com, 2015)

e. Property taxes (...) are way too high compared with neighboring states. (Omaha World-Herald, 2017)

Obviously, the use of enough/too does not require the existence of infinitival complements. To have a unified account for both E/T constructions as well as the data in (15) and (16), we need much simpler lexical entries for enough and too. The mechanisms underlying the implicative reading of E/T constructions should not be part of the lexical semantics proper of enough/too.
the interval serving as the comparative standard

\[ \text{enough: reaching the lower bound} \quad \text{too: exceeding the upper bound} \]

Figure 1: The lexical semantics of \textit{enough} and \textit{too}.
\textit{Enough} means reaching the lower bound of an interval, while \textit{too} means exceeding the upper bound of an interval.

As shown in (18), the semantics of gradable adjectives is analyzed as relations between intervals (of type \(\langle dt\rangle\)) and entities (of type \(e\)). For the absolute use of gradable adjectives, the interval argument is a context-dependent interval \(I^C\) (see (18a)), which means ‘the context-dependent interval such that it is from the lower to the upper bound of being tall for a relevant comparison class’. Then in (18b), \(6'\) can be interpreted either (i) as a singleton set (for the ‘exactly \(6’\) reading) or (ii) as an interval with \(6'\) as its lower bound (for the ‘at least \(6’\) reading).

\[
(18) \quad [[tall]]_{(dt,e)} \overset{\text{def}}{=} \lambda I_{(dt)}, \lambda x_e, \text{HEIGHT}(x) \subseteq I
\]

\[\begin{align*}
a. & \quad [[\text{John is tall}]] \equiv \text{HEIGHT}(\text{John}) \subseteq I^C \quad \text{absolute use of gradable adjectives} \\
b. & \quad (i) \quad [[\text{John is } 6' \text{ tall}]] \equiv \text{HEIGHT}(\text{John}) \subseteq [6', 6'] \quad \text{‘exactly } 6'\text{’ reading} \\
& \quad \quad (ii) \quad [[\text{John is } 6' \text{ tall}]] \equiv \text{HEIGHT}(\text{John}) \subseteq [6', +\infty) \quad \text{‘at least } 6'\text{’ reading}
\end{align*}\]

\textit{More/-er} is analyzed as the default differential in comparative sentences – \((0, +\infty)\): it refers to the largest possible range of positive degrees (see (19a)). Then, \textit{little} changes the polarity of an interval (see (19b)). Based on the semantics of \textit{more} and \textit{little}, \textit{less} means the default differential in \textit{less-than} comparatives: it refers to the largest possible range of negative degrees (see (19c)). Finally, \textit{(th)-an} encodes an interval subtraction (see (17) and (19d)).

\[
(19) \quad \begin{align*}
a. & \quad [[\text{more/-er}]]_{(dt)} \overset{\text{def}}{=} (0, +\infty) \quad \text{(i.e., the default range of \textit{positive} degrees)} \\
b. & \quad [[\text{little}]]_{(dt)} \overset{\text{def}}{=} \lambda I_{(dt)}, [0, 0] - I \quad \text{(see Zhang and Ling 2017b)} \\
c. & \quad [[\text{less}]]_{(dt)} \overset{\text{def}}{=} [[\text{little}}][[\text{more/-er}]] = (-\infty, 0) \quad \text{(i.e., the default range of \textit{negative} degrees)} \\
d. & \quad [[(\text{th)-an}]]_{(dt)} \overset{\text{def}}{=} \lambda I_{\text{std}}, \lambda I_{\text{diff}}, \Omega[I - I_{\text{std}} = I_{\text{diff}}]
\end{align*}\]

(20) illustrates how to derive the meaning of a comparative sentence. Here the comparative standard denotes a range of values, and the interval-arithmetic-based framework precisely characterizes the sentence meaning and the semantic contribution of the comparative standard.

\[
(20) \quad [[\text{Lucinda is taller than every boy is}]] = [[\text{tall}[[\text{-er} \text{-an th}-\text{every boy is (tall)}][\text{Lucinda}]]] \\
\hspace{1cm} \Rightarrow \text{HEIGHT}(\text{Lucinda}) \subseteq \Omega[I - [[\text{the}}][[\text{every boy is (tall)}]] = (0, +\infty)] \quad \text{(see (18): [[tall]])} \\
\hspace{1cm} \Rightarrow \text{HEIGHT}(\text{Lu}) \subseteq \Omega[I - [[\text{the}}][[\lambda x \text{ boy}(x) \rightarrow \text{HEIGHT}(x) \subseteq I']]] = (0, +\infty)] \\
\hspace{1cm} \Rightarrow \text{HEIGHT}(\text{Lucinda}) \subseteq (\text{the-interval-including-every-boy’s-height-upper-bound }, +\infty) \quad \text{(see (17): interval subtraction)}
\]

Based on these, I analyze \textit{enough} as ‘not less (than)’, and \textit{too} as ‘more (than)’ (see (21) and (23)): \textit{enough} means reaching the lower bound of an interval \(I\), while \textit{too} means exceeding the upper bound. Similar to numbers (see (18b-i)), \textit{enough} also has an ‘exactly’ reading (see (22)).
(21) [[John was strong \textbf{enough} compared to his classmates]] \hspace{2cm} (see (15c))
= [[strong \textbf{not less-	ext{an} th-[his classmates are strong]}}] [John]]
\Leftrightarrow \text{STRENGTH}(\text{John}) \subseteq U(\lambda I[1 - [[\text{the}][[\text{his classmates are strong}]]) = (-\infty, 0])
\Leftrightarrow \text{STRENGTH}(\text{John}) \subseteq U\backslash(-\infty, \text{lower-bound}) \cup (U = (-\infty, +\infty)
\Leftrightarrow \text{STRENGTH}(\text{John}) \subseteq [I_{\text{lower-bound}}
\therefore [[\text{enough}]]_{(dt,et)} \equiv \lambda_{(dt,et)} \lambda_{x_{e}G-DIMENSION(e,dt)}(x) \subseteq [I_{\text{lower-bound}}, +\infty)
(i.e., \text{enough} means reaching the lower bound of an interval, the lower bound included.)

(22) The ‘exactly’ reading of \textbf{enough}: reaching the singleton set of the lower bound
[[\text{enough}]]_{(dt,et), (dt,et)} \equiv \lambda_{(dt,et)} \lambda_{x_{e}G-DIMENSION(e,dt)}(x) = [I_{\text{lower-bound}}, I_{\text{lower-bound}}]
E.g., The city hides 3,000 eggs in an annual Easter egg hunt (...), which is \textbf{more than enough} for the 200 children who usually show up. (\textit{COCA, The Detroit News, 2017})

(23) [[This laptop was \textbf{too} expensive compared to similar items]] \hspace{2cm} (see (16c))
= [[expensive \textbf{more-	ext{an} th-[similar items are expensive]}}] [this laptop]]
\Leftrightarrow \text{PRICE}(\text{this laptop}) \subseteq d[I - [[\text{the}][[\text{similar items are expensive}]]) = (0, +\infty)]
\Leftrightarrow \text{PRICE}(\text{this laptop}) \subseteq (I_{\text{upper-bound}})
\therefore [[\text{too}]]_{(dt,et), (dt,et)} \equiv \lambda_{(dt,et)} \lambda_{x_{e}G-DIMENSION(e,dt)}(x) \subseteq (I_{\text{upper-bound}}, +\infty)
(i.e., \text{too} means exceeding the upper bound of an interval, the upper bound excluded.)

As illustrated in (24), comparatives (in particular those containing modals in their \textit{than}-clause) and \textbf{enough/\text{too}-sentences are interchangeable in terms of truth conditions. The current account reflects exactly this interchangeability: \textbf{enough} and \textbf{too} are analyzed as variations of comparative morphemes \textit{more/less}. Intriguingly, this interchangeability also shows that modals are not part of the meaning of \textbf{enough/\text{too}. Instead, when modals are involved, they are part of the overtly expressed or contextually suggested comparative standard.

(24) \textbf{Context:} Cal wants to be a fighter pilot. Air Force regulations require all pilots to be between 5'4" and 6'5" tall.
\hspace{1cm} a. If Cal is 6'6",
\hspace{1.5cm} Cal is \textbf{taller than} required = Cal is \textbf{too tall} (to be a pilot).
\hspace{1cm} b. If Cal is 5'4",
\hspace{1.5cm} Cal is \textbf{not less tall than} required = Cal is \textbf{tall enough} (to be a pilot).

In sum, empirical evidence shows that \textbf{enough/\text{too} does not always take an infinitival complement. Thus, by reducing \textbf{enough/\text{too} to degree modifiers, I have excluded hidden modals or two-way entailment from their lexical semantics. In the \textbf{enough/\text{too}-sentences in (24), it is the optional infinitival phrase to be a pilot that involves a modal element and contributes to the expression of comparative standard. In the next section, I show that in terms of syntax and semantics, the infinitival complement of \textbf{genuine E/T constructions} (see (1)) is totally different from the phrase to be a pilot in (24). Then I further explain the source and the nature of the implicative reading of genuine E/T constructions.}
4. Causal dependence in the interpretation of E/T constructions

Having shown that not all enough-/too-sentences contain an infinitive, now I show that not all enough-/too-sentences containing an infinitive are genuine E/T constructions that have an implicative reading. Essentially, I argue that genuine E/T constructions with an implicative reading have a bi-clausal structure, while non-genuine E/T constructions have a mono-clausal structure. Section 4.1 presents the diagnostics of these two types of sentences. Then, Section 4.2 shows that the interpretation of bi-clausal E/T constructions involves causal dependence.

4.1. E/T constructions: bi-clausal vs. mono-clausal

At first sight, it seems that sentences (25a) and (25b) (hereafter called the chess-sentence and the party-sentence respectively) have the same syntactic structure, both containing an infinitive, but intuitively, we feel that only the party-sentence has an implicative reading. I will use four diagnostics to show that these two sentences actually have different syntactic structures.

(25) a. Context: Jerry was a talented kid. He wanted to learn to play chess. This club only admitted kids with an IQ of 120 from low-income families. (chess-sentence)
   Jerry was clever enough to join this chess club.
   Jerry joined this chess club.
   b. Context: Towards the end of the party last night, the air conditioner stopped working. Those who kept staying there caught cold. (party-sentence)
   Mary was clever enough to leave the party early.

First, under the given context, the infinitive in the chess-sentence can be omitted (since we can accommodate the comparative standard) or replaced by similar expressions that contribute to the expression of comparative standard (e.g., for joining this chess club, etc.), with no difference in meaning. As evidence, all the four sentences in (26a) are natural continuations here. In contrast, for the infinitive in the party-sentence, its omission or replacement by expressions like for leaving the party early would lead to differences in meaning. As evidence, among the three sentences in (26b), only (26b-i) sounds a natural continuation.

(26) Diagnostic (I): whether the infinitive is omittable or replaceable

   a. Jerry was a talented kid. He wanted to learn to play chess. This club only admitted kids with an IQ of 120 from low-income families . . .
      (i) Jerry was clever enough to join this chess club.
      (ii) Jerry was clever enough. = (26a-i)
      (iii) Jerry was clever enough for joining this chess club. = (26a-i)
      (iv) Jerry was clever enough with regard to the threshold of IQ. = (26a-i)
   b. Towards the end of the party last night, the air conditioner stopped working. Those who kept staying there caught cold . . .
      (i) Mary was clever enough to leave the party early. a natural continuation
      (ii) ?Mary was clever enough. ≠ (26b-i)
      (iii) #Mary was clever enough for leaving the party early. ≠ (26b-i)
      (This sounds like there’s a qualification for leaving early.)
Second, (27a) shows that the chess-sentence can be nominalized without a change in meaning: for both the original and the nominalized versions, it is Jerry’s cleverness that pleased his mother. In contrast, (27b) shows that the party-sentence cannot be nominalized without a change in meaning: for the original party-sentence, it is Mary’s early leaving from the party that pleased her mother, but for the nominalized one, it seems that it is rather Mary’s cleverness that pleased her mother.\(^7\) Intriguingly, the semantic contrast shown in (27b) suggests that semantically speaking, the main information of the original party-sentence is not Mary’s cleverness, but rather her early leaving from the party.

\((27)\) **Diagnostic (II):** whether the sentence can be paraphrased with nominalization

- **a.** Context: Jerry was a talented kid. He wanted to learn to play chess. This chess club only admitted kids with an IQ of 120 from low-income families.
  1. Jerry was clever enough to join the club, so his mother was happy. =
  2. Jerry’s sufficient cleverness to join the club makes his mother happy.
- **b.** Context: Towards the end of the party last night, the air conditioner stopped working. Those who kept staying there caught cold.
  1. Mary was clever enough to leave the party early, so her mother was happy.
  2. Mary’s sufficient cleverness to leave early makes her mother happy.

Third, (28a) shows that the chess-sentence cannot be turned into a ‘be adj. enough so that’ version without a change in meaning. The semantic difference between (28a-i) and (28a-ii) can be shown by adding but his family was too rich. Due to its entailment that *Jerry joined this chess club*, sentence (28a-ii) sounds contradictory, but sentence (28a-i) does not have this entailment and does not sound contradictory. In contrast, (28b) shows that the party-sentence can be paraphrased with a ‘be-adj.-enough-so-that’ sentence without a change in meaning: (28b-i) and (28b-ii) have the same meaning.

\((28)\) **Diagnostic (III):** whether the ‘adj.-enough-to’-sentence can be paraphrased with a ‘be-adj.-enough-so-that’ sentence

- **a.** Context: Jerry was a talented kid. He wanted to learn to play chess. This chess club only admitted kids with an IQ of 120 from low-income families.
  1. Jerry was clever enough to join this chess club, but his family was too rich. – **no contradiction**
  2. Jerry was clever enough so that he joined this chess club, but his family was too rich. – **contradiction**
- **b.** Context: Towards the end of the party last night, the air conditioner stopped working. Those who kept staying there caught cold.
  1. Mary was clever enough to leave the party early.
  2. Mary was clever enough so that she left the party early.

\(^7\)The nominalized version in (27b), i.e., (27b-ii), might not even be grammatical. According to Pesetsky (1991) and Pesetsky and Torrego (2001, 2004, 2006) (see Wurmbrand 2014), English infinitives can combine with nominalized irrealis predicates, but not with nominalized propositional, implicative, or factive predicates. Though it is unclear whether most native speakers of English would judge sentence (27b-ii) grammatical or not, it is certain that even if it is grammatical, the semantic contrast shown in (27) holds.
Fourth, modal elements can be inferred from context (29a), and thus, both (29a-i) and (29a-ii) mean that Jerry’s cleverness reaches the required value. However, given the context (29b), interlocutors cannot accommodate any requirement, and thus different from the felicitous sentence (29b-i), sentence (29b-ii) is infelicitous. Thus, sentence (29a-i) is interchangeable with a comparative containing a deontic modal in its than-clause, but sentence (29b-i) is not. This contrast suggests that while the infinitive of the chess-sentence conveys a certain modality, the infinitive of the party-sentence is actually irrelevant to the expression of any modality.

(29) **Diagnostic (IV):** whether the sentence can be interchangeable with a comparative containing a deontic modal in its than-clause

a. Context: Jerry was a talented kid. He wanted to learn to play chess. This chess club only admitted kids with an IQ of 120 from low-income families.
   (i) Jerry was clever enough to join this chess club.
   (ii) Jerry was not less clever than he was **required** to be. = (29a-i)

b. Context: Towards the end of the party last night, the air conditioner stopped working. Those who kept staying there caught cold.
   (i) Mary was clever enough to leave the party early.
   (ii) #Mary was not less clever than she was **required** to be. ≠ (29b-i)

In sum, these diagnostics suggest that the party-sentence (25b) is bi-clausal, including a **comparative** and an **infinitive**. Semantically, it is actually this infinitive that carries the main information (see Diagnostic (II)). Thus, this infinitive cannot be optional, and the whole sentence cannot be nominalized or reduced to a comparative. Crucially, this infinitive is not part of a comparative: it is not related to comparative standard, and it does not contribute any modal elements. Therefore, as shown in Table 1, there are two categories for **enough-too**-sentences involving an infinitive. Only the interpretation of bi-clausal E/T constructions is implicative and involves causal dependence between its two clauses: the comparative part serves as a cause, and the infinitive serves as a consequence.
4.2. The semantics of E/T constructions: necessary vs. sufficient causes

Having shown that the implicative reading of genuine E/T constructions is due to its bi-clausal structure, here I further characterize the nature of this implicative reading. Inspired by Schulz (2011), Baglini and Francez (2015), and Nadathur (2016), I propose that causal dependence is involved in the interpretation of genuine E/T constructions. As illustrated in (30), bi-clausal E/T constructions can be paraphrased with the use of because: their infinitival complement represents a consequence, which causally depends on the factor expressed by the comparative.\(^8\)

\[(30) \quad \begin{align*}
a. \quad & [[M. was clever enough to leave early]] = [[M. left early because she was clever enough]] \\
b. \quad & [[Bill was too tired to stay awake]] = [[Bill didn’t stay awake because he was too tired]]
\end{align*}\]

The intuition here is that under a given context (e.g., (25b)), (30a) means that among many other factors (e.g., her willingness to sacrifice fun for health), Mary’s cleverness (in decision-making) in this situation was a necessary (but not necessarily sufficient) one for her early leaving from the party, while (30b) means that among many other factors (e.g., his lack of effort to stay awake), Bill’s excessive fatigue was a sufficient (but not necessarily necessary) one for his not staying awake.

I adopt the framework of Schulz (2011) to formally describe the causal dependence between the two clauses of E/T constructions:

\[(31) \quad \begin{align*}
a. \quad & \text{A dynamics } D \text{ represents causal relationships over a set of propositions } \mathcal{P}. \\
b. \quad & D \text{ includes} \\
& \quad \text{(i) a set of background variables } B \text{ which are causally independent,} \\
& \quad \text{(ii) a set of inner variables } I = \mathcal{P} - B, \\
& \quad \text{(iii) the function } F \text{ that associates every inner variable } X \text{ with} \\
& \quad \text{(I) a set of propositions } Z_X \text{ that } X \text{ directly causally depends on,} \\
& \quad \text{and (II) a two-valued truth function } f_X \text{ that describes} \\
& \quad \text{how to calculate the truth value of } X \text{ from the values of the members of } Z_X. \\
c. \quad & \text{A situation } s \text{ is an incomplete valuation of the propositions in } \mathcal{P}, \text{ mapping } \mathcal{P} \text{ to } \{0, 1, u\}, \text{ where } u \text{ means undetermined.} \\
d. \quad & \text{Operator } T_D \text{ maps situations } s \text{ to new situations } T_D(s), \text{ calculating the direct}
\end{align*}\]

\(^8\text{In fact, this kind of bi-clausal causal-dependence-related constructions are not limited to E/T constructions, as illustrated by (i). (i) means that grass is green, which is a factor contributing to the promotion of photosynthesis.}\)
causal effects of the settings in $s$. After a finite number of applications of $T^*_D$, the least fixed point $s^*_D$ is reached. (see Figure 2 for an example.)

Based on these definitions, Baglini and Francez (2015) defines the notions of causal sufficiency (see (32a)) and causal necessity (see (32b)). Evidently, when $s_D$ is causally sufficient for $\phi$, then $s_D$ causally entails $\phi$, i.e., $s_D \vDash \phi$. $s_D$ is causally necessary for $\phi$ when there is no $s'$ (where $\phi$ is still undetermined) different from $s_D$ that causally entails $\phi$, i.e., $s' \vDash \neg \phi$.

\begin{align}
\text{(32) a. } & \text{ Let } \Sigma \text{ be a set of literals and } D \text{ a dynamics. Then } s_D \vDash \phi \text{ iff } \llbracket \phi \rrbracket^{D,s^*_D}_\Sigma = 1 \\
& \text{(i.e., } s_D \text{ causally entails } \phi \text{ given } D \text{ iff } \phi \text{ is true on the least fixed point } s^*_D) \\
\text{b. } & \phi \vDash_D s_D \text{ iff } \exists s' : \begin{array}{l}
\begin{array}{l}
\begin{array}{l}
s' \neq s_D \\
\land s'(\phi) \neq 1 \\
\land s'(\phi) = 1 \\
s' \vDash \phi
\end{array}
\end{array}
\end{array}
\text{in the values of determined variables relevant for } \phi
\end{align}

For E/T constructions, the causal dependence between the comparative ($C$) and the infinitive ($X$) is formally described in (33). Obviously, as noted by Baglini and Francez (2015), the choice of dynamics (in particular what background and inner variables are under consideration) plays a crucial role in analyzing causal dependence. Thus, following Baglini and Francez (2015), I choose particular contexts to construct dynamics and provide empirical evidence for (33).

\begin{align}
\text{(33) The causal dependence between } C \text{ and } X \text{ in E/T constructions:} \\
\text{a. } & \text{enough-sentences: } \begin{array}{c}
\neg C \vDash \neg X
\end{array} \text{ It is not necessary that } C \text{ is causally sufficient for } X,
\text{b. } & \text{too-sentences: } \begin{array}{c}
C \vDash \neg X
\end{array} \text{ It is not necessary that } C \text{ is causally necessary for } \neg X.
\end{align}

In enough-sentences, $C$ is causally necessary for $X$. (34) shows that enough-sentences are infelicitous under contexts where $C = 0 \land X = 1$. Thus, $C$ has to be causally necessary for $X$.

(34) Towards the end of the party last night, the air conditioner stopped working. Those who kept staying there caught cold. Mary was drunk, but Jo took her back early.

\begin{itemize}
\item What happened to Mary?
\item #– Mary was clever enough to leave the party early.
\item (C = Mary was clever enough. $X$ = Mary left early.)
\end{itemize}

In enough-sentences, $C$ can be causally insufficient for $X$. For (35), $F(X) = \langle Z_X = \{C,K\}, f_X = (X \leftrightarrow K \land C)\rangle$. The felicitous answer (35a) shows that $C$ can be an insufficient factor for $X$.

(35) Towards the end of the party last night, the air conditioner stopped working. Those who kept staying there caught cold. Mary made a wise decision, and since she stayed sober, she drove back early herself.

\begin{itemize}
\item What happened to Mary?
\item $\checkmark$– Mary was clever enough to leave the party early.
\item (X = Mary left early, C = Mary was clever enough, K = Mary stayed sober.)
\end{itemize}
In too-sentences, C is causally sufficient for ¬X. (36) shows that too-sentences are infelicitous under contexts where ¬X ↞ C. Thus C alone has to be sufficient for ¬X. Note that under (36), the answer Bill was too busy to come last night sounds misleading, and those who know the whole context have very good reason to claim that this answer misses the crucial point.

(36) If we don’t invite Bill, Bill comes only if he is not overly busy. But if we invite Bill, he comes no matter whether he is busy or not. Last night, we didn’t invite Bill, and Bill was overly busy, so he didn’t come. – What happened to Bill?
   a. ?– Bill was too busy to come last night.
      (X = Bill came, C = Bill was overly busy, K = Bill wasn’t invited.)

In too-sentences, C can be causally unnecessary for ¬X. For (37), F(X) = ⟨Z_X = {C, K}, f_X = (¬X ⇔ K ∨ C)⟩. For those who know the whole context, the answer (37a) is still acceptable and truthful, suggesting that C can be an unnecessary factor for X.

(37) Bill does not come if he is overly busy or sick. Last night, he was both overly busy and sick, so he didn’t come. – What happened to Bill?
   a. ∨ ¬ Bill was too busy to come last night.
      (X = Bill came, C = Bill was overly busy, K = Bill was sick.)

A further prediction of the current account is that since positive enough-sentences contain a necessary (but not necessarily sufficient) cause for their infinitival complement to be true, negative enough-sentences should contain a sufficient (but not necessarily necessary) cause for their infinitival complement to be false; while since positive too-sentences contain a sufficient (but not necessarily necessary) cause for their infinitival complement to be false, negative too-sentences should contain a necessary (but not necessarily sufficient) cause for their infinitival complement to be true. (38) and (39) show that this prediction is perfectly borne out.

(38) a. Mary was clever enough to leave early.  ~→ Mary left early.
   b. Mary was not clever enough to leave early.  ~→ Mary didn’t leave early.

(39) a. Bill was too busy to come last night.  ~→ Bill didn’t come last night.
   b. Bill was not too busy to come last night.  ~→ Bill came last night.

This kind of pattern for the implicative reading of positive and negative E/T constructions is actually due to the lexical semantics of enough/too and their interplay with negation in creating dual relations, as sketched out in (40). Overall, the current account characterizes the nature of the implicative reading of positive and negative E/T constructions in a precise way.

(40) a. [[clever enough]] = [[not too stupid]]    ~→ a necessary (but not necessarily sufficient) cause for the infinitival complement to be realized
   b. [[not clever enough]] = [[too stupid]]    ~→ a sufficient (but not necessarily necessary) cause for the negation of the infinitival complement to be realized
Table 2: Wurmbrand (2014)’s framework on tense properties of English infinitives

<table>
<thead>
<tr>
<th>infinitive type</th>
<th>examples</th>
<th>syntax</th>
<th>episodic interpretation</th>
<th>temporal composition of infinitive</th>
</tr>
</thead>
<tbody>
<tr>
<td>irrealis future</td>
<td>decide, expect</td>
<td>control</td>
<td>possible</td>
<td>woll</td>
</tr>
<tr>
<td>propositional</td>
<td>claim</td>
<td>control</td>
<td>impossible</td>
<td>reference time is attitude holder’s now</td>
</tr>
<tr>
<td>non-propositional; no attitude holder</td>
<td>manage</td>
<td>control</td>
<td>dependent on matrix tense</td>
<td>reference time is matrix reference time</td>
</tr>
</tbody>
</table>

5. The tense and aspect of the infinitival complement of E/T constructions

According to Wurmbrand (2014), infinitives are not semantically tenseless. As shown in Table 2, her framework for tense properties of English infinitives includes three classes: (i) future irrealis infinitives, (ii) those expressing propositional attitude reports, and (iii) those involving no attitude holder.

Here I argue that the infinitives of bi-clausal E/T constructions fall into the third class. There are at least two reasons for this. First, similar to manage-sentences, E/T constructions involve no attitude holders. Second, Faraci (1974) has shown that the infinitives in E/T constructions (even including for-phrases, e.g., Mary runs too fast for me to keep up with her) are reduced sentential objects (i.e., smaller than CP or even TP), which makes them similar to the infinitival complement of core restructuring predicates like manage (see Wurmbrand 2001, 2004). Thus, as a consequence, E/T constructions constitute a single temporal domain, and the tense and aspect (or rather episodicity in the framework of Wurmbrand 2014) of their infinitival complement are reflected on the syntactically main predicate of the sentence.

Though Wurmbrand (2014)’s framework focuses on English infinitives, it seems generalizable to cross-linguistic data. For example, Marques (2012) notes that for Portuguese implicative E/T constructions, temporal overlap between the main predicate and the infinitive is required. This is a natural consequence if Wurmbrand (2014)’s analysis also works for Portuguese infinitives.

As mentioned earlier, for French E/T constructions, there seems a correlation between aspect and implication. An explanation is easily available if Wurmbrand (2014)’s analysis can be extended to French. In French, imperfective and perfective aspects are used to characterize generic and episodic events respectively. Thus, since the implicative reading of an E/T construction typically describes an episodic event (e.g., Mary was nice enough to come last night), its semantic aspect is perfective, leading to a perfective marker on the main predicate in French.

In other words, it is the episodicity of the entailed event that dictates the requirement for the aspect of the main predicate, not the other way round. This explains why the aspect of the main predicate is not a perfect indicator for the implicative reading (see the discussion of Hacquard 2006 and Nadathur 2017): a non-genuine E/T construction is a comparative and thus usually in imperfective, but sometimes it can also be in perfective.
6. Summary and outlook

This paper addresses the semantics of enough/too and E/T constructions. It includes three components: (i) an interval-based account for the lexical semantics of enough/too; (ii) a causality-based account for the semantics of E/T constructions; and (iii) a brief analysis of the semantic tense and aspect of the infinitival complement in E/T constructions. The conclusion is that enough and too are essentially variations of comparatives (i.e., enough means not less (than) and too means more (than)), but bi-clausal E/T constructions are real implicatives. To some extent, I agree with Nadathur (2017) that enough and too are not implicatives, but I also agree with Hacquard (2005, 2006) that (bi-clausal) E/T constructions are real implicatives. Crucially, by showing that genuine E/T constructions are bi-clausal, I attribute the source of implicative readings to this bi-clausal structure, not to the lexical semantics proper of enough/too. Moreover, by showing that implicative readings do not necessarily rely on the existence of two-way entailment or a sufficient and necessary condition, the current analysis more precisely characterizes the interpretation pattern of E/T constructions. As mentioned in Section 4, the pattern of causal dependence in the interpretation of positive and negative E/T constructions is related to the lexical semantics of enough/too, then is there a unified underlying mechanism for the interpretation pattern of the whole inventory of implicatives (see (41))? Syntactically, do implicatives all involve restructuring (cross-linguistically)? These are left for future research.

(41) Implicatives
   a. Involving a necessary cause for the infinitival complement to be realized: French pouvoir (e.g., Jean a pu aller means John went because he could, see Bhatt 1999), enough to, not too to, manage to (see Baglini and Francez 2015), . . .
   b. Involving a sufficient cause for the negation of the infinitival complement to be realized: too to, not enough to, fail to . . .

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An analysis of the semantic variability of weak adjuncts and its problems
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Abstract. This paper addresses the question of how to account for the semantic variability of weak free adjuncts. Weak free adjuncts are non-clausal adjuncts that associate with an argument of the main predicate, contribute propositional content, and can interact with temporal or modal operators, which leads to different, adverbial-clause-like interpretations. I focus on a specific type of weak adjuncts, non-clausal \textit{as}-phrases, and propose a unified semantic analysis for the full range of interpretational possibilities that takes into account the interpretational contingency on different syntactic positions. I show that this analysis improves on Stump’s (1985) original analysis of weak adjuncts. I then go on to discuss the limitations of both Stump’s account and the unified account. Both accounts fail to capture that the interaction of weak adjuncts with modal operators underlies certain restrictions on the properties of the modal operators—an observation that has not been discussed in the literature so far.

Keywords: weak free adjuncts, semantic variability, \textit{as}-phrases, temporal/modal operators.

1. Introduction

Free adjuncts are non-clausal adjuncts that associate with an argument of the main predicate (the “associated constituent”) and contribute propositional content about the denotation of that argument (the “associated individual”). Types of free adjuncts are, for instance, nominal, non-clausal \textit{as}-phrases, see (1), and non-clausal phrases headed by gerunds, see (2).\(^1\) While all free adjuncts fall under the above description, Stump (1985) notes that some free adjuncts give rise to an ambiguity in the case that they co-occur with a temporal or modal operator, see the \textit{as}-phrases in (1). Stump calls free adjuncts of this kind “\textit{weak (free) adjuncts}” and free adjuncts that do not give rise to such an ambiguity “\textit{strong (free) adjuncts}”.

\begin{align*}
\text{(1) a. } & \text{\textbf{As a child, Peter} got in for free.} & \text{(past tense operator)} \\
& \text{(Possible: When Peter was a child, he got in for free.)} \\
& \text{(Possible: Since Peter is/was a child, he got in for free.)} \\
\text{b. } & \text{\textbf{As a child, Peter} would get in for free.} & \text{(\textit{would}, modal operator)} \\
& \text{(Possible: Since Peter is a child, he would get in for free.)} \\
& \text{(Possible: If Peter were a child, he would get in for free.)}
\end{align*}

Sentences that contain a weak adjunct and a temporal/modal operator can be interpreted in such a way that the weak adjunct contributes causal-clause-like content (paraphrasable by a \textit{since}-clause) and/or either temporal-clause-like or conditional-antecedent-like content (de-}

\(^1\)I would like to thank Ryan Bochnak, Kai von Fintel, Nina Haslinger, Irene Heim, Carina Kauf, Magda Kaufmann, Stefan Kaufmann, Edith Scheifele, Thomas Weskott, as well as the audiences at Sinn und Bedeutung 22 (Potsdam), LingLunch (MIT), the Meaning Group (UConn), and the colloquium at the German Department of the University of Vienna for helpful questions and discussion. This work was supported by a postdoc fellowship of the German Academic Exchange Service (DAAD).

\(^2\)The \textit{as}-phrases discussed in this paper are Class 4 \textit{as}-phrases following the classification of English non-clausal \textit{as}-phrases in Zobel 2016, 2017a.
pending on the co-occurring type of operator), compare (1a) and (1b). For weak adjuncts in episodic sentences in the present tense (e.g., as a child, Peter is getting in for free), only the causal-clause-like interpretation is available. For strong adjuncts, by contrast, the presence of a temporal/modal operator has no effect. They always contribute causal-clause-like content, see being a child in (2).

(2) **Being a child.** Peter would get in for free.

(Only possible: Since Peter is a child, he would get in for free.)

(Not possible: If Peter were a child, he would get in for free.)

Stump (1985) proposes the first formal semantic account for the semantic variability of weak adjuncts in the context of Montague grammar. His main strategy for capturing the range of observed contributions is to derive them using tailor-made semantic transformations. The first major aim of this paper is to present an analysis of weak adjuncts and their semantic variability that (i) retains Stump’s general intuitions about the semantic contribution of weak adjuncts but (ii) derives these from a unified proposal for the semantics of weak adjuncts without recourse to semantic transformations. The second major aim is to address the predictions and limitations of Stump’s proposal and this unified account. A closer look at the interaction of weak adjuncts and modal auxiliaries will yield further desiderata for an adequate analysis of weak adjuncts, which are not met by either proposal.

The paper is structured as follows. Section 2 provides a brief characterization of Stump’s formal proposal. In Section 3, I present an alternative, unified analysis of weak adjuncts that takes their semantic variability to be a result of the relative flexibility of weak adjuncts with respect to their syntactic adjunction sites. The limitations of both Stump’s and the alternative account are discussed in Section 4. There, I show that the interaction between weak adjuncts and modal operators is much more restricted than previously assumed, and that these restrictions are also in effect with other semantic phenomena. Section 5 concludes the paper.

2. Stump’s (1985) analysis of the semantic variability of weak free adjuncts

In his dissertation, Stump (1985) presents a fully worked out Montague fragment of English that is designed to deal specifically with the semantics of free adjuncts. The fragment is comprised of (i) a categorial grammar, (ii) an intensional logic, and (iii) a syntax-semantics-interface (i.e., a list of interpretation rules) that translates syntactic structures into logical expressions. For each node in a syntactic structure, the syntax-semantics-interface provides a category-specific interpretation rule. These rules are sensitive to the semantic type and features of the node’s daughter expressions (i.e., the argument expression(s) of the rule), and the result of applying these rules in a step-wise manner are $\lambda$-expressions that are part of the intensional logic. In addition to effecting composition of their arguments, the interpretation rules may introduce additional, potentially underspecified material (e.g., free variables) into the resulting $\lambda$-expressions, which are valued subsequently via a pragmatic process.\

3A Montague fragment is a formal system for the analysis of natural language in the spirit of the work of Richard Montague, e.g., modelled after Montague 1973.

4For a more elaborate exposition of Stump’s system, I ask the interested reader to directly refer to Stump 1985.
The main tenet of Stump’s proposal for weak adjuncts is that they are semantically variable because their semantic contribution in each specific instance can parallel that of the adverbial clause with which they are paraphrased. Formally, this is implemented by dedicated interpretation rules that transform the basic semantic contribution of weak adjunct as-phrases in such a way that the resulting semantics mirrors the contribution and compositional behavior of the corresponding adverbial clauses. The basic semantic contribution of weak and strong free adjuncts, according to Stump, describes a set of times; (3) provides the basic semantics for as a child.\(^5\)

\[
\begin{align*}
(3) \quad \lambda t. \lambda x^t[R(x^t,y^t) \& \exists z^t[R(x^t,z^t) \& \text{child'}(z^t)]]) & \quad \text{(type } \langle i,t \rangle) \\
\Leftrightarrow \lambda t. \lambda x^t[R(x^t,y^t) \& \text{child'}(y^t)] & \quad \text{(type } \langle i,t \rangle) \\
\text{IN PROSE: The set of times } t \text{ such that } y \text{'s stage } x \text{ at } t \text{ is a child-stage.}^6
\end{align*}
\]

Notably, this basic meaning never directly combines with other expressions to derive the various interpretations observed for weak adjuncts. In each specific instance, it is first transformed (guided by the “right” syntactic categories) into expressions that parallel the corresponding adverbial clauses. This means, of course, that the semantic contribution of one and the same weak adjunct can differ quite radically depending on its use. Example (4) shows the result of applying the relevant rules to (3) to capture the causal-clause-like and the conditional-antecedent-like uses exhibited by as a child in (1b).

\[
\begin{align*}
(4) \quad & \text{a. As a child interpreted as a causal clause: } \quad \text{(type } \langle \langle i,t \rangle, \langle i,t \rangle \rangle) \\
& \lambda P. \lambda t. \lambda x^t[R(x^t,y^t) \& \lambda t'. \lambda x^t[R(x^t,y^t) \& \text{child'}(y^t)]](P(t)) \\
& \text{b. As a child interpreted as a conditional antecedent: } \quad \text{(type } t) \\
& \exists t. \exists t. R(t', \exists t. R(t', y^t) \& \text{child'}(y^t))
\end{align*}
\]

The expression in (4a) denotes a modifier that takes the contribution of the main clause as an argument \((P)\) and relates the proposition \(P(t)\) via some contextually determined (typically, causal) relation \(L\) to the proposition built from the basic contribution of the weak adjunct (first argument of \(\lambda x^t[R(x^t,y^t) \& \text{child'}(y^t)]\)). In contrast, the expression in (4b) simply denotes a proposition (i.e., there is a time \(t\) at which the content contributed by the weak adjunct holds). The conditional-antecedent-like interpretation, Stump proposes (following Kratzer 1977), arises from using (4b) as the first argument/restrictor of a co-occurring modal quantifier.

In the introduction, we have seen that weak adjuncts can also interact with past tense in episodic sentences, see (1a). Stump does not discuss this case. Given the proposed parallelism between weak adjuncts and adverbial clauses, he arguably would have suggested an analysis that parallels that of temporal adverbial clauses, which are of type \(\langle \langle i,t \rangle, \langle i,t \rangle \rangle\). To analyze this case adequately, new interpretation rules are needed, though.\(^7\)

\(^5\)Stump proposes a semantics for as, but never explicitly analyzes full as-phrases. The analyses in (3) and (4) are the result of applying Stump’s rules to his denotation for as and indefinite NPs. I also slightly modernize Stump’s notation. The superscripts on \(x, y, \) and \(z\) indicate whether a variable ranges over individuals \((i)\) or stages \((s)\) and \(R\) is the relation that relates individuals and their stages in the sense of Carlson 1977.

\(^6\)The variable \(y\) is contextually identified with the associated individual.

\(^7\)Even though (4a) has type \(\langle \langle i,t \rangle, \langle i,t \rangle \rangle\), it would not provide the right semantic contribution for the temporal-clause-like cases given Stump’s own analysis of temporal adverbial clauses.
While Stump’s proposal manages to capture the semantic variability of weak adjuncts, his analysis is ultimately dissatisfying. As described above, his main strategy is to introduce tailor-made interpretation rules to capture each of the interpretational possibilities of weak adjuncts. This results in an analysis that only restates the main observation—i.e., weak adjuncts are flexible with respect to which relation is understood to hold between their contribution and the content contributed by the main clause.

In the following section, I use the case of weak adjunct as-phrases to show that in a system that follows the general principles outlined in Heim and Kratzer 1998, the central observation that weak adjuncts can behave like different adverbial clauses can be captured without recourse to specialized interpretation rules. The main assumption underlying this account is that weak adjuncts are flexible with respect to where they are base generated and interpreted.8

3. A unified analysis of the semantic variability of weak adjunct as-phrases

3.1. The semantic contribution of as-phrases

To start out, I propose a basic analysis of weak adjunct as-phrases. Following Emonds (1984), Stump (1985), and Jäger (2003), I assume that as serves a function similar to that of the copula in predicational copular sentences.9 Recent analyses of predicational copular clauses assume that the copula takes only one argument, a Small Clause (i.e., a phrase that contains both a non-verbal predicate and its subject; see e.g., Matushansky and Spector 2005). Consider (5).

(5) a. Peter is a child.
    b. \[[vP \text{ is } [SC \text{ Peter } [DP \text{ a child}]]]\]

I directly adopt this idea for my proposal for the syntactic structure of as-phrases in (6).

(6) \[[asP \text{ as } [SC \text{ PRO } [DP \text{ a child}]]]\]

Unlike the Small Clauses in copular sentences, a Small Clause in the complement of as does not have an overt subject but contains the covert pronoun PRO. The semantic value of PRO is provided by the associated constituent (i.e., the argument of the main predicate with which the as-phrase associates; see the introduction). Following Williams (1992), Adler (2006), and Flaate (2007), I assume that this association dependency can be captured formally by assuming that PRO is non-obligatorily controlled by that associated argument.

Semantically, as, just like the copula, contributes an identity function over propositions (cf. Matushansky and Spector 2005). That is, as takes a propositional argument \(p\) (type \(\langle i, \langle s, t \rangle \rangle\)) and returns it unchanged, see (7).10

8Stump employs categorial grammar to analyze sentences close to their surface. Hence, the avenue to link the observed semantic flexibility to an underlying structural difference that is resolved by movement (see below) is not open to him.
9Emonds (1984) calls as a/the “prepositional copula”.
10This analysis ignores the differences between as and the copula. For a discussion of these differences see Stump 1985 and Jäger 2003.
\[
\text{as}^{w_0,t_0,g} = \lambda p_{\langle i,\langle s,t \rangle \rangle}.p \quad \text{(type } \langle \langle i,\langle s,t \rangle \rangle, \langle i,\langle s,t \rangle \rangle \rangle)\]
\]

The Small Clause in the complement of \textit{as} contributes propositional content, see (8); for the purposes of this analysis, I assume that the referent of PRO, which is determined via non-obligatory control, is assigned by the variable assignment \(g\).

\[(8) \quad \left[\text{[SC PRO a child]}\right]^{w_0,t_0,g} = \lambda t.\lambda w.\text{child}'(g(i))(t)(w) \quad \text{(type } \langle i,\langle s,t \rangle \rangle)\]

To derive the contribution of the full \textit{as}-phrase in (6), we need to combine (7) with (8). Given that \textit{as} contributes an identity function, the result of this combination in (9) is identical to (8).

\[(9) \quad \left[\text{as [SC PRO a child]}\right]^{w_0,t_0,g} = \lambda t.\lambda w.\text{child}'(g(i))(t)(w) \quad \text{(type } \langle i,\langle s,t \rangle \rangle)\]

\text{IN PROSE: The proposition that is true for a world } w \text{ and a time } t \text{ iff the associated individual } g(i) \text{ is a child at } t \text{ in } w.

The proposal in (9) directly mirrors Stump’s basic meaning in (3). In contrast to Stump, I argue that (9) suffices to capture the full range of interpretations given one basic assumption: weak adjunct \textit{as}-phrases can be base generated wherever they are interpretable (i.e., wherever they can be composed with their sister nodes). The sentence-initial position found for the full range of possible interpretations of \textit{as a child} in (1) is the result of movement from different underlying base positions. This movement is later reconstructed at LF prior to interpretation.

Which positions are viable base positions for weak adjuncts is determined by the syntactic and semantic status of weak adjuncts. Since they are modifiers, I assume that they combine with the denotations of their sister nodes via a generalized form of Predicate Modification (Heim and Kratzer 1998). Hence, \textit{as}-phrases can adjoin to any node of type \(\langle i,\langle s,t \rangle \rangle\).

Which nodes are of type \(\langle i,\langle s,t \rangle \rangle\)? For the basic syntactic structure of a sentence, I adopt the sequence of functional projections in Beck and von Stechow 2015, see (10). Furthermore, I follow their assumption that the lexical material below AspP jointly builds up a time- and world-independent eventuality description. Unlike Beck and von Stechow (2015), however, I assume that, after existential closure of this eventuality description by the head of Asp, the branching nodes along the functional spine have a uniform semantic type; they are all time- and world-dependent (i.e., of type \(\langle i,\langle s,t \rangle \rangle\)).

To my knowledge, there is no established semantic proposal for how to model non-obligatory control into adjuncts that attach high in the syntactic structure. For a discussion of the properties of this type of control see Adler 2006. For the moment, I assume that the value assigned by \(g\) is fixed by some independent mechanism.

This predicts that the sentence-initial position is not the only position in which weak adjunct \textit{as}-phrases are found. This is borne out: they can also occur in sentence-final position.

(i) ?Peter gets in for free as a child.

The slight marginality of (i), I suggest, arises because sentence-final \textit{as}-phrases are preferably read as \textit{as}-phrases of Class 3; these are \textit{as}-phrases that specify the role or function in which the associated individual participated in the eventuality described by the main predicate (see Zobel 2016, 2017a).

I diverge from Beck and von Stechow (2015) in how I model intensionality because, unlike these authors, I do not assume that time/world variables and their binders are syntactically represented.
The semantic variability of weak adjuncts can now be reduced to the different adjunction sites occupied by different weak adjuncts. Specifically, the choice of adjunction site will determine which of the operators introduced in the functional heads along this spine will be able to interact with the content contributed by the weak adjunct. Any operator that has scope over the weak adjunct will have an effect on the time or world of evaluation of its content. For operators that sit in a position below the base-generation site of the weak adjunct, though, the adjunct and its time and world of evaluation will be “out of reach”. What this means for specific cases is made explicit in the upcoming subsections.

3.2. The temporal-clause-like interpretation

The temporal-clause-like interpretation of weak adjuncts arises from the interaction of their content with a temporal operator. In the case of (1a) (i.e., As a child, Paul got in for free), for instance, the temporal-clause-like interpretation arises from the as-phrase being adjoined to a node in the scope of the temporal operator [PAST], see (11).

![Diagram of TP, PAST, AspP1, AspP2, asP, vP, PRO, a child, Peter, get in for free]

To derive the semantics of (11), I start out by assuming that AspP1 has the denotation in (12).

\[
[\text{AspP}_1 \text{ Asp Peter, get in for free}]^{w_0,t_0,s} = \\
\lambda t'. \lambda w. \exists e [e \in w \land t' \supseteq \tau(e) \land \text{get-in-for-free'}(\text{Peter})(e)]
\]

Since AspP1 is of type \(\langle i, \langle s, t \rangle \rangle\), its contribution in (12) and the contribution of the as-phrase in (9), which is also of type \(\langle i, \langle s, t \rangle \rangle\), can be composed using Generalized Predicate Modification, which results in the denotation of AspP2 in (13).

\[
[\text{AspP}_2 \text{ as a child . . . free}]^{w_0,t_0,s} = \\
\lambda t'. \lambda w. \text{child'}(g(i))(t')(w) \land \exists e [e \in w \land t' \supseteq \tau(e) \land \text{get-in-for-free'}(\text{Peter})(e)]
\]

Next, the denotation of [PAST], given in (14), is applied to (13). This results in the final proposal for the denotation of (11) in (15).

---

14The effect of applying Generalized Predicate Modification to two functions of the same type \(\langle \alpha_1, \ldots, \langle \alpha_n, t \rangle \ldots \rangle\) is (i) identification of the arguments of matching types in the order in which they are given and (ii) conjunction of the descriptive material. The resulting expression also has the type \(\langle \alpha_1, \ldots, \langle \alpha_n, t \rangle \ldots \rangle\).
The effect of [PAST] is to shift the time \( t' \) (i.e., the reference/topic time of the clause) into the past of the overall time of evaluation \( t \) of the sentence. One result of the composition step illustrated in (13) is the identification of the temporal argument of the as-phrase content with the temporal argument of the denotation of AspP\(_1\). As a result of this identification, the as-phrase content further specifies the reference/topic time \( t' \) in (15). Since further specifying the reference/topic time \( t' \) is the task that is usually served by temporal adverbials, the present proposal manages to capture the temporal-clause-like interpretation of weak adjunct as--phrases that arises as a result of the semantic interaction with temporal operators like [PAST].

3.3. The conditional-antecedent-like interpretation

The conditional-antecedent-like interpretation observed for weak adjunct as-phrases arises as a result of their interaction with modal operators. For instance, the conditional-like interpretation of (1b) (i.e., If Peter were a child, he would get in for free) can be attributed to the interaction of the as-phrase content with the modal operator contributed by would.

To capture this interpretation of (1b), I adopt Stump’s basic idea that if an as-phrase co-occurs with a modal auxiliary, it can restrict the modal quantifier contributed by this auxiliary in the same manner as an if-clause. Instead of taking if-clauses to be arguments of modal auxiliaries (see Stump’s proposal in Section 2), however, I adopt the basic syntactic and semantic analysis of conditionals in von Stechow 2004. Following von Stechow, I assume that if-clauses modify a free variable \( f_{cb} \), which is an argument of the modal auxiliary and contributes its conversational background (i.e., the restrictor). The value of \( f_{cb} \) is a proposition (type \( ⟨i,⟨s,t⟩⟩⟩ \)); it is the conjunction of all contextually determined background assumptions with respect to which the necessity or possibility expressed by the corresponding modal auxiliary is determined (see Kratzer 2012). Since as-phrases can be adjoined to any node of type \( ⟨i,⟨s,t⟩⟩⟩ \) (see Section 3.1), they can also adjoin to \( f_{cb} \).

For (1b), the conditional-antecedent-like interpretation arises as a result of the as-phrase modifying the value assigned to the variable \( f_{cb} \), which contributes the restrictor of the co-occurring modal operator contributed by would, see (16).\(^{15}\)

\(^{15}\)Following Ippolito (2013) among others, I take would to spell out the universal modal operator WOLL in the scope of [PAST]. Since the question whether [PAST] in this context expresses regular temporal precedence or so-called “fake past” is orthogonal to my concerns (but see the discussion in Ippolito 2013), I arbitrarily assign to [PAST] its regular temporal interpretation.
To start out, let us first derive the contribution of the modal restricted by \(f_{cb}\) after it has been modified by the \(as\)-phrase (i.e., the denotation of the \(X'\)-node). First, I assume that WOLL expresses universal quantification over worlds. It takes two propositional arguments: its restrictor \(q\) and its scope \(p\), see (17).

\[
[WOLL]_{w_0,t_0,g} = \lambda q_{(i,(s,t))}. \lambda p_{(i,(s,t))}. \lambda t. \lambda w. \forall w' : q(t)(w')[p(t)(w')]
\]

Second, the denotation of the \(X\)-node, which contributes the modified restrictor for WOLL and fills its first propositional argument, is derived by applying Generalized Predicate Modification to \(f_{cb}\) and the \(as\)-phrase content, see (18).

\[
[[X \ f_{cb} \ as \ PRO \ a \ child]]_{w_0,t_0,g} = \lambda t. \lambda w. f_{cb}(t)(w) & \ \text{child}'(g(i))(t)(w)
\]

After applying (17) to (18), we obtain the denotation in (19) for the \(X'\)-node. The \(X'\)-node denotes a modal operator that takes a proposition \(p\), a world \(w\), and a time \(t\) as its arguments and outputs true iff for all worlds \(w'\) in which \(f_{cb}\) is true at \(t\) and \(g(i)\) is a child at \(t\), the proposition \(p\) is true at \(t\) in \(w'\).

\[
[X']_{w_0,t_0,g} = \lambda p_{(i,(s,t))}. \lambda t. \lambda w. \forall w' : f_{cb}(t)(w') & \ \text{child}'(g(i))(t)(w')[p(t)(w')]
\]

The propositional argument slot of (19) is filled in the next composition step by the denotation of AspP\(_1\) in (20) (repeats (12)). The result is given in (21).

\[
[[\text{AspP}_1 \ Asp \ Peter, \ get \ in \ for \ free]]_{w_0,t_0,g} = \lambda t'. \lambda w. \exists e[e \in w & t' \supseteq \tau(e) & \text{get-in-for-free'}(\text{Peter})(e)]
\]

\[
[[\text{IP} \ f_{cb} \ \ldots \ \text{for free}]]_{w_0,t_0,g} = \lambda t'. \lambda w. \forall w' : f_{cb}(t')(w') & \ \text{child}'(g(i))(t')(w')[\exists e[e \in w' & t' \supseteq \tau(e) & \text{get-in-for-free'}(\text{Peter})(e)]]
\]

In the last composition step, the denotation of [PAST] (see (14) in Section 3.2) is applied to (21). By this, we obtain the final proposal in (22) for the denotation of (16).

\[
\lambda t. \lambda w. \exists t' \leq t & \ \forall w' : f_{cb}(t')(w') & \ \text{child}'(g(i))(t')(w')[\exists e[e \in w' & t' \supseteq \tau(e) & \text{get-in-for-free'}(\text{Peter})(e)]]
\]

In prose: (22) holds for \(t\) and \(w\) iff there is time \(t'\) preceding \(t\) such that for all worlds \(w'\) in which \(f_{cb}\) holds at \(t'\) and Peter is a child at \(t'\), there is an event \(e\) at \(t'\) of Peter getting in for free.
As in Section 3.2, the desired interpretation is ensured by the assumption that *as*-phrases can be base generated and interpreted in any position in which they are sister to a node of type \( \langle i, \langle s, t \rangle \rangle \). Hence, the conditional-antecedent-like interpretation and the temporal-clause-like interpretation are captured in an entirely parallel fashion.\(^{16}\)

### 3.4. The causal-clause-like interpretation

The causal-clause-like interpretation has a special status among the potential interpretations of weak adjuncts. It is the only interpretation that is always available, regardless of any co-occurring temporal or modal operators; and it is the only interpretation that is also available for strong free adjuncts (see the introduction).

Recall the strategy that was pursued in the previous subsections to model the interaction with temporal/modal operators: the *as*-phrase was argued to adjoin in a position where it directly modifies the restrictor or scope of a given operator. This ensures that the time and/or world argument inside the *as*-phrase content becomes dependent on this operator. Hence, to capture the independence of the causal-clause-like interpretation, I assume that the *as*-phrase adjoins to a position in the clause that is outside the scope of any temporal/modal operator.\(^{17}\) In what follows, I discuss this idea based on the example of the causal-clause-like interpretation of (1a) (i.e., *As a child, Paul got in for free*), see the syntactic structure in (23).

\[
\begin{align*}
\text{TP}_2 & \quad \text{TP}_1 \\
\text{asP} & \quad \text{AspP}_1 \\
\text{as \ PRO}_i \ a \ child & \quad \text{[PAST]} \\
\text{Asp} & \quad \text{vP} \\
\text{Peter} & \quad \text{get in for free}
\end{align*}
\]

To derive the interpretation of (23), the temporal operator [PAST] (see Section 3.2) first composes with the denotation of AspP\(_1\) (= (20)). This results in the denotation of TP\(_1\) in (24).

\[(24) \quad \llbracket \text{TP}_1 \ [\text{PAST}] \ \text{Asp} \ \text{Peter} \ \text{get in for free} \rrbracket^{w_0, t_0, g_c} = \lambda t. \lambda w. \exists e \ [t' \leq t \land \exists e \ [e \text{ in } w \land t' \supseteq \tau(e) \land \text{get-in-for-free}'(\text{Peter})(e)]]\]

\(^{16}\)The analysis provided in this subsection could in principle be adapted for an analysis of modal auxiliaries that utilizes a modal base and an ordering source: all steps that involve \( f_{cb} \) have to be performed for a variable of type \( \langle i, \langle s, t \rangle \rangle \) that brings in the modal base of the corresponding modal auxiliary (see Kratzer 2012).

\(^{17}\)This is not to say that strong free adjuncts can only adjoin to positions outside the scope of temporal and modal operators. There might be other reasons for why strong free adjuncts and these operators do not interact. Stump (1985), for instance, argues that strong free adjuncts are individual level predicates, while weak free adjuncts are stage level predicates. This distinction, Stump suggests, has an impact on their semantic behavior and prevents strong free adjuncts from scoping under temporal and modal operators. Jäger (2003) translates this into the idea that weak free adjuncts can take small situation-sized arguments, while strong free adjuncts can only be predicated of world-sized arguments and, hence, cannot restrict temporal/modal quantifiers. I remain agnostic regarding the difference between weak and strong free adjuncts as this question is orthogonal to the present concerns.
The denotation of TP₁ is of type \( ⟨i,⟨s,t⟩⟩ \). Hence, (24) can be composed with the denotation of the adjoined as-phrase via Generalized Predicate Modification. The result is given in (25).

\[
(25) \quad \lambda t. \lambda w. \text{child'}(g(i))(t)(w) \land \exists t' \leq t \land \exists e \ln w \land t' \supseteq \tau(e) \land \text{g-i-f-f'}(\text{Peter})(e))
\]

In prose: (25) holds for \( w \) and \( t \) iff Peter is child at \( t \) in \( w \), and there is a time \( t' \) preceding \( t \) that includes the runtime of an event \( e \) in \( w \) of Peter getting in for free.

Since the as-phrase is adjoined in a position above TP, the time and world of evaluation for the as-phrase content are the time \( t \) and world \( w \) of evaluation of the entire sentence, which are pragmatically identified with the time \( t₀ \) and world \( w₀ \) of utterance.

How does (25) capture the causal-clause-like interpretation of (1a)? The short answer is: it doesn’t. As it stands, the result in (25) of the step-wise interpretation procedure is semantically equivalent to Peter is a child, (and) he got in for free. I assume, following Jäger (2003), that the explanation relation between the first and the second conjunct in (25) is inferred pragmatically using the same mechanism that allows us to infer similar discourse relations between independent utterances, as in (26) (see Asher and Lascarides 2003).

\[
(26) \quad \text{Peter got in for free. He is a child.}
\]

The two sentences in (26) are preferably understood such that the second sentence provides an explanation for the validity of the first sentence. Similarly, the content contributed by the as-phrase is understood as providing an explanation for the validity of the content contributed by the remaining material in the clause.

Of course, this parallel between (1a) and (26) is only suggestive. A fully worked-out proposal has to be left for future work. I will, however, discuss two observations that concern the optionality of the explanation relation, which supports the decision not to hard-code an explanation relation into the denotation of weak adjunct as-phrases.

First, we observe that the explanation relation understood in the context of the causal-clause-like interpretation is not obligatorily present in the temporal-clause-like interpretation. Example (27), for instance, does not convey that Peter’s being a child explains his being blond—only that Peter was blond when he was a child. If an explanation relation were an integral part of the semantics of as-phrases, this strict temporal contribution could not be explained.¹⁸

\[
(27) \quad \text{As a child, Peter had blond hair.}
\]

Second, the explanation relation only seems to be the default link that is inferred to connect the propositional as-phrase content and the proposition expressed by the remainder of the sentence. In the right supporting contexts we can also infer a concessive relation, see (28).

\[
(28) \quad \text{I was shocked by Peter’s confession. As a doctor, he smokes 50 cigarettes a day!}
\]

¹⁸The same, in fact, holds for the conditional-antecedent-like interpretation, but this may be harder to see because of the rule-like connection between the restrictor and the scope that is established by the modal operator.
In the given context, the second sentence in (28) is most naturally understood as conveying that Peter smokes 50 cigarettes a day even though he is a doctor (i.e., doctors usually do not smoke 50 cigarettes a day). Crucially, we do not interpret his being a doctor as an explanation for his smoking habits.

At the moment, the exact conditions that underlie the causal-clause-like and the concessive-clause-like interpretations are unclear to me. What is clear, though, is that the relation that is to be understood cannot be attributed to the semantics of the as-phrase or any co-occurring operator. I need to leave the missing details for further investigation.

3.5. Comparing Stump’s original account to the present proposal

The aim for the proposal outlined in Sections 3.1–3.4 was to capture the same range of interpretations as Stump’s account. The resulting proposal is, however, not “just” a translation of Stump’s account into another system. In this subsection, I show that the two accounts differ in their predictions, and that the present proposal captures patterns in the data that Stump’s account fails to predict. The present analysis, therefore, must be seen as a refinement of Stump’s.

The relevant data concerns the possible interpretation of sentences that contain two as-phrases (one sentence-initially and one sentence-finally, see fn. 12) and a co-occurring temporal or modal operator, as in (29).

(29)  a. As a shy person, Peter was quiet as a child. ([PAST])
     b. As a runner, Peter would have fun as a participant of this course. (would)

We observe that the relative positions of the two as-phrases in a clause constrain the possible interpretations of the two occurrences. Even though (29a) contains two as-phrases that could in principle both interact with [PAST], only the second as-phrase, as a child, can (and indeed must) interact with it. The first as-phrase, as a shy person, can only be given a causal-clause-like interpretation. Analogously in (29b), only the second as-phrase, as a participant of this course, can (and must) interact with would; the first as-phrase, as a runner, can again only be understood as causal-clause-like.

The present proposal can straightforwardly account for the data in (29). The causal-clause-like interpretation results from a higher syntactic position than either the temporal-clause-like or the conditional-antecedent-like interpretation. Assuming that the height of syntactic attachment is reflected in the surface position of an expression, we expect the relative linear order of co-occurring as-phrases to affect the range of available interpretations.

Stump’s account, in contrast, does not predict the relative order of two co-occurring as-phrases to constrain their interpretational possibilities. For any of the two as-phrases in (29b), for instance, their contributed content could be transformed into either the content that underlies the causal-clause-like interpretation (see (4a) in Section 2), or the content that underlies the conditional-antecedent-like interpretation (see (4b) in Section 2). Hence, Stump’s account pre-
dicts (29b) to be ambiguous, contrary to fact.

4. Limitations of Stump’s account and the present account

In the previous section I presented an account for the semantic variability of weak adjunct *as*-phrases that aimed at capturing the various interpretations that were observed for weak adjuncts in the literature, notably Stump 1985. I proposed that the observed variability is the result of different attachment sites to which weak adjuncts can adjoin. In this respect, my proposal differs from Stump’s proposal, who assumes semantic transformations of basic underlying content. In this section, I present data that is problematic for both Stump’s and the current proposal. The aim is to identify which of the assumptions about the data need to be revised, and which patterns ultimately need to be captured.

The main problem for both accounts is connected to the conditional-antecedent-like interpretation. The analysis in both accounts predicts that weak adjuncts can behave *just like* conditional clauses (e.g., *if*-clauses). Despite some parallels between weak adjuncts and conditional clauses, this is not borne out. In fact, closer examination of the data shows that the interaction between weak adjuncts and modal operators is restricted to a specific subset of modal operators (pace Stump 1985) that can be shown to pattern together in other respects, as well.

4.1. Differences between *if*-clauses and weak adjunct *as*-phrases

The first difference between *as*-phrases and *if*-clauses is that *as*-phrases depend on the presence of an overt modal operator for their conditional-antecedent-like interpretation. *If*-clauses, in contrast, can also restrict covert modals (see Kratzer 2012). Compare (30a) to (30b).

(30) a. If Peter is an administrator, he has his office on the third floor.
   b. As an administrator, Peter has his office on the third floor.

Even though the main clause in (30a) does not contain an overt modal, the *if*-clause is interpreted as a conditional antecedent. This is attributed to the presence of a covert epistemic universal modal, similar to overt *must*, that is restricted by the *if*-clause. In contrast, the *as*-phrase in (30b) can only be understood with a causal-clause-like interpretation; the conditional-antecedent-like interpretation is, crucially, unavailable.

Neither Stump’s account nor the present account can capture this difference. Stump’s interpretation rules are designed to assimilate weak adjuncts to *if*-clauses so that exactly the same combination rules can apply to the two types of expressions. Whether the modal operator involved is overt or covert should not make a difference for the applicability of these rules. The same holds for the present account. The adjunction site that allows an *as*-phrase to modify $f_{cb}$

---

For instance, *as*-phrases in their conditional-antecedent-like interpretation can conjoin with *if*-clauses, see (i).

(i) As an adult and if he had had enough money, Peter could have watched the movie.

For reasons of simplicity, I will restrict the subsequent discussion to *if*-clauses. Similar observations can be made for conditional clauses introduced by other subjunctors (e.g., *when* or *whenever*).
is available whenever a modal operator is present and does not depend on its (c)overtness.

The second difference between *as*-phrases and *if*-clauses regards the types of overt modal operators that they can restrict. Stump (1985: 53–57) argues that weak adjuncts can restrict any modal with any interpretation, just like *if*-clauses. This is in fact not the case. Closer inspection shows that weak adjunct *as*-phrases are able to restrict future-oriented *will*, future-oriented *might*, *would*, and other subjunctive marked modals. They, however, do not interact with modals in the indicative with an epistemic or root interpretation (i.e., deontic, bouletic, teleological, or ability; see Portner 2009). Compare (31)–(33) to (34)–(36).

(31) **[Context: Peter’s aunt loves caviar, but she could never afford to buy it. Last week, she learnt that she was going to inherit a lot of money from a rich, distant relative when they were going to die.]**

*Peter:* As a millionaire, she will eat caviar every day. (future-oriented *will*)

(32) **[Context: Mary asks Susan whether it would be a good idea to have Peter join the day cruise on the Charles River.]**

*Susan:* As a participant, Peter might annoy the other passengers on the boat, and the trip would not be as nice.

(33) **[Context: Peter was murdered. He died from a blow to the head. The detective knows that the cook is innocent because she has an alibi for the time of the murder. Nevertheless, he considers how the cook would have killed Peter.]**

*Detective:* As the culprit, the cook would have used her favorite frying pan.

Examples (31)–(33) contain future-oriented *will/might* and *would*, and in these examples, the contribution of the *as*-phrases can be paraphrased with the corresponding *if*-clauses. This is, in fact, the only available interpretation of (31)–(33) given the contexts that are provided: the causal-clause-like interpretation requires it to be established (based on what the speaker knows) that the property contributed by the *as*-phrase applies to the associated individual at the time of utterance; this is not the case in any of the scenarios. This follows from the observation that *as*-phrases in their causal-clause-like interpretation pattern with *since*-clauses; see Iatridou 1991 and Charnavel 2017. Hence, the observation that the utterances in (31)–(33) are coherent in the given contexts allows us to conclude that the conditional-antecedent-like interpretation is in fact available. Matters are different in (34)–(36).

(34) **[Context: Peter was murdered. He died from a blow to the head. The detective believes that either the gardener or the butler did it.]** (intended: epistemic *might*)

*Detective:* #As the culprit, the gardener might have used his spade. The spade fits with Peter’s injuries.

(35) **[Context: Peter was beaten up. The main suspect at this point in the investigation is Peter’s cook, who has a criminal record.]** (intended: deontic *have to*)

*Detective:* #As the culprit, the cook has to go to jail.

---

21 This follows from the observation that *as*-phrases in their causal-clause-like interpretation pattern with *since*-clauses; see Iatridou 1991 and Charnavel 2017.
The candidates for the local election will be announced today. Peter knows that Susan was considering to run for office, but he doesn’t know what she decided to do in the end. (intended: bouletic/teleological must)

Peter: #As a candidate, Susan must overcome her awkwardness (to have a chance).

Examples (34)–(36) were constructed using the same strategy as in (31)–(33) to exclude the causal-clause-like interpretation. Hence, the conditional-antecedent-like interpretation would be the only plausible interpretation for these as-phrases. Since the native speakers I consulted uniformly judge the utterances in (34)–(36) as odd in the given contexts, I conclude that the conditional-antecedent-like interpretation is unavailable for the as-phrases in (34)–(36).

In sum, we find that the conditional-antecedent-like interpretation depends on the presence of an overt modal that is not an indicative modal with an epistemic or root interpretation. Neither Stump’s analysis nor the proposal in Section 3 can account for these restrictions; in the two analyses, the availability of the conditional-antecedent-like interpretation is fully independent of the properties of the co-occurring modal operator.

4.2. Modals allowing for the conditional-antecedent-like interpretation

What is the property that future-oriented will, future-oriented might, would, and other subjunctive-marked modals share that might be decisive for the availability of the conditional-antecedent-like interpretation? Looking at the assortment of modals, one might suspect that the factor that decides which modals interact with weak adjuncts is future temporal orientation. Future-orientatedness, however, turns out not to make the right distinction: root interpretations are assumed to be uniformly future-oriented but do not show any interaction with weak adjuncts (see Rullmann and Matthewson 2017).

Closer inspection reveals that future-oriented will differs from future-oriented might, would, and other subjunctive-marked modals and has to be considered independently. The decisive difference between will and the other modals in this group is that the conditional-antecedent-like interpretation with will cannot be subject to “iffiness” (i.e., the speaker has to be relatively certain that the as-phrase content will apply to the associated individual, see von Fintel and Iatridou 2002). This lack of “iffiness” is reflected in the observation that with future-oriented will, the as-phrase has to be paraphrased with a when-clause instead of an if-clause; compare (31) to (32) and (33). This suggests that the interaction of weak adjuncts with will is closer to the interaction with temporal operators than the interaction with the other modals. For reasons of space, the necessary details need to be left to future work.

The remaining modal operators (i.e., future-oriented might, would, and other subjunctive-marked modals) are all irrealis modals. They share the ability to occur in different varieties of past- and future-oriented subjunctive conditionals (see Iatridou 1991 for an overview). In addition, they all (at least diachronically) feature some form of morphological irrealis marking

22 Similarly, the decisive factor cannot be temporal perspective, either. All modals can have either past or present temporal perspective. For a discussion of these notions see Rullmann and Matthewson 2017.
Semantically, irrealis modals differ from all other modals and modal flavours, which I will call “realis” modals/flavors, in that irrealis modals can access various linguistically or contextually provided material to “build” their restrictors in case these are not provided by overt material. This ability of irrealis modals is reflected in the following two ways. First, irrealis modals in simple subjunctives are able to extract their restrictors from topic-marked, presupposed, and presumed material (see Kasper 1992, Schueler 2008). The modal would in (37a), for instance, can be restricted by a precondition of Peter’s passing the test—i.e., that Peter takes part in the test. In contrast, the deontically interpreted modal have to in (37b) cannot be understood as restricted in the same way.

(37)  
a. Peter would have passed the test.  
(irrealis would)  
(≈ If Peter had written the test, he would have passed it.)  
b. Peter has to pass the test.  
(deontic/realis have to)  
(Cannot mean: If Peter writes the test, he has to pass it.)

Second, irrealis modals, in contrast to realis modals, allow for modal subordination (see a.o. Roberts 1989, 2015). The third person singular pronoun it in (38a), which features irrealis might, can be anaphoric to the indefinite NP a bar of chocolate in the preceding sentence. No such anaphoric dependency is available for it in the parallel (38b), which contains realis can.

(38)  
a. I could leave a bar of chocolate for you in the fridge.  
My brother might eat it, though.  
(irrealis might)  
(≈ If I leave a bar of chocolate in the fridge, my brother might eat it.)  
b. #My brother can eat it, though.  
(realis can)  
(Cannot mean: If I leave a bar of chocolate in the fridge, my brother can eat it.)

I argue that it is this property of irrealis modals—the property that allows us to reconstruct their restrictor and that renders modal subordination possible—that underlies the possibility of weak adjuncts to restrict these modals. By assuming this general characteristic, I make two predictions: (i) other temporal/modal operators that allow for contextual restriction allow for modal subordination and vice versa, and (ii) weak adjuncts can have a conditional-antecedent-like interpretation with operators of this kind.

Grounding my judgment on the discussion in the literature about simple subjunctives and modal subordination, prediction (i) seems to be borne out. Other temporal/modal operators that have been argued to pattern with irrealis modals with respect to both phenomena are adverbs of quantification and the generic/habitual operator (see a.o. von Fintel 1994, Krifka et al. 1995, Roberts 1989, 2015). For both adverbs of quantification and the generic/habitual operator, we find that they also interact with weak adjuncts to give a conditional-like interpretation (see Stump 1985). This is illustrated in (39), where the weak adjunct as-phrase is shown to interact with and restrict the adverb of quantification often and the generic/habitual operator. Hence, the second prediction in (ii) is also borne out.
As a passenger of Lufthansa, Peter often compliments the flight attendants.  
(≈ Often, when Peter flies with Lufthansa, Peter compliments . . . )

As a passenger of Lufthansa, Peter orders as many beverages as possible.  
(≈ Whenever Peter flies with Lufthansa, he orders . . . )

In sum, we see that the modal operators in the restricted class that allows for the conditional-antecedent-like interpretation of weak adjuncts share a property that is also decisive with respect to the availability of other interpretational phenomena. What all of these phenomena have in common is that the temporal/modal operators that are involved in them need to be restrictable by material from the linguistic and extra-linguistic context. The conditional-antecedent-like interpretation of weak adjuncts, hence, illustrates a general distinction among temporal/modal operators, which needs to be addressed further. Since this investigation is beyond the scope of this paper, though, it has to be left for future work.

4.3. Implications for the account of weak adjunct as-phrases

The discussion in Sections 4.1 and 4.2 has direct implications for Stump’s account and the account presented in Section 3: the conditional-like-interpretation cannot be the result of either a direct semantic transformation (as in Stump 1985), or of weak adjuncts restricting the free restrictor variables provided by temporal/modal operators directly (as in the present account). Instead, the modal facts point us towards an indirect mechanism.

The first step towards this indirect mechanism is to realize that, contrary to what is assumed in Stump 1985 and in Section 3, the content contributed by weak adjunct as-phrases is presuppositional. Example (40) shows that the content contributed by as a child (i.e., that Peter is a child) projects from under entailment cancelling operators: it is neither affected by negation nor interpreted inside questions or conditional antecedents.

This is not an entirely new observation. Jäger (2003) shows for a different type of as-phrases (Class 3 in Zobel 2016, 2017a), that they are presuppositional. He, however, indirectly also argues for a presuppositional analysis of weak adjunct as-phrases because he conflates Class 3 as-phrases with weak adjunct as-phrases (Class 4 in Zobel 2016, 2017a). Even though Jäger’s choice to conflate Class 3 as-phrases with weak adjunct as-phrases is problematic (see Zobel 2017a), (40) shows that his observation that some as-phrases contribute presuppositional content extends to weak adjunct as-phrases and, I suggest, to weak adjuncts in general.

This observation has, of course, direct consequences for the temporal-clause-like and the causal-clause-like interpretation of weak adjuncts. In fact, most aspects of Stump’s account and the account presented in Section 3 need to be reconsidered. One aspect of the present account
should, however, be preserved. From the discussion of the advantages of that account in Section 3.5, we have learnt that the linear order (or rather the hierarchical configuration) of two co-occurring as-phrases has an impact on the interpretational possibilities of sentences with two as-phrases. Hence, any proposal that aims to capture the behavior of weak adjuncts in general and weak adjunct as-phrases in particular should combine a presuppositional analysis of their contribution with the observation that the interpretational differences are connected to different syntactic positions. A sketch of an implementation that combines these two desiderata is given in Zobel 2017b. A full account that captures the wider implications discussed above has to await another occasion.

5. Conclusion

In the first part of this paper (Sections 2 and 3), I presented and discussed two proposals that aim to account for the semantic variability of weak adjuncts that results from the interaction of weak adjuncts with temporal or modal operators: (i) the proposal put forth in Stump 1985 and (ii) a new, alternative account that aims to capture the full range of interpretational possibilities of weak adjuncts by connecting the different interpretations to different adjunction sites. I argued that the latter account is to be preferred because it allows us to capture the lack of ambiguity of sentences that contain more than one weak adjunct as-phrase.

In the second part of the paper (Section 4), I showed that the interaction between weak adjuncts and modal operators is much more restricted than previously assumed, which leads to problems for both accounts presented before. We observed that the conditional-antecedent-like interpretation of weak adjuncts is only available with a subset of modal expressions: future-oriented will, future-oriented might, would, and other subjunctive-marked modals. I connected this subset to two other phenomena, simple subjunctives and modal subordination, and argued that the central, shared characteristic of these expressions is their ability to access certain contextually given material to “construe” missing restrictors. Weak adjuncts, I argued, provide material of the necessary kind—they contribute presuppositional content.

Together, these two parts identified two general desiderata for an adequate analysis of weak adjuncts: a proposal for the semantics of weak adjuncts should assign to them presuppositional content and be sensitive to their syntactic adjunction site.

References


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