The semantics of declarative and interrogative lists*

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This manuscript was written in the Spring/Summer of 2015. In September 2017 some references were updated and the appendices, which mainly contained 'notes to self', were deleted. No other edits were made. The paper is still far from finished, but should be readable in its current form and might be interesting for people working on the topics that it addresses.

*Many ideas presented in this paper were shaped through close collaborations with various people over the last couple of years, initially focusing on disjunctive questions and gradually expanding to what I now think of as declarative and interrogative lists. I started thinking about disjunctive questions with Jeroen Groenendijk in the Fall of 2008, and we sketched an account of such questions in Groenendijk and Roelofsen (2009). In the Spring of 2009, I pursued a somewhat more detailed account together with Sam van Gool, which was presented in Roelofsen and van Gool (2010). Then, while at UMass for the year 2009/10, I collaborated intensely with Kathryn Pruitt, who had already worked on disjunctive questions herself before my visit (Pruitt, 2007, 2008). This collaboration led to one joint paper focusing on prosody (Pruitt and Roelofsen, 2013) and a detailed handout focusing on syntax and semantics (Pruitt and Roelofsen, 2011). In the Summer of 2010 I moved back to Amsterdam, and continued to work with Ivano Ciardelli and Jeroen Groenendijk on the inquisitive semantics framework. Especially relevant for the analysis of disjunctive questions was the development of a *presuppositional* inquisitive semantics. Some first steps in this direction were taken in Ciardelli *et al.* (2012). In 2011-2013, I spent the winters in Santa Cruz, working with Adrian Brasoveanu and Donka Farkas. With Donka I developed an account of polarity particle responses (*yes*/*no*) (Roelofsen and Farkas, 2015), which led to many further insights into the semantics of declaratives and interrogatives, especially ones involving disjunction and negation, because these elements dramatically affect the extent to which a sentence licenses polarity particle responses. Finally, insights obtained in recent work with Ivano Ciardelli on so-called *Hurford disjunctions* (Ciardelli and Roelofsen, 2017) have important repercussions for declarative and interrogative lists as well. I am very grateful for all these fruitful and joyful collaborations and I hope that the present paper provides a reasonable synthesis and further development of the ideas that they have spawned. I am also very grateful to Maria Aloni, Lucas Champollion, Liz Coppock, Michele Herbstritt, Edgar Onea, Anna Szabolcsi, Nadine Theiler, Wataru Uegaki, Matthijs Westera, and audiences at Stanford University, the University of Rochester, the University of Massachusetts Amherst, University College London, the University of Stuttgart, the University of Amsterdam, and the Third Questions in Discourse Workshop in Berlin for lots of useful feedback and discussion. Finally, I gratefully acknowledge financial support from the Netherlands Organisation for Scientific Research (NWO).

Contents

1 Introduction

This paper is concerned with sentences that consist of one or more declarative or interrogative clauses separated by disjunction, with different intonation patterns. Some representative examples are given in (1)-(5) below (in these examples, and throughout the paper, ↑ and ↓ indicate rising and falling pitch contours, respectively).

(1) Igor speaks English↓.

(2) Igor speaks English↑.

(3) Does Igor speak English↑?

(4) Does Igor speak English↑ or does he speak French↓?

(5) Does Igor speak English↑ or does he speak French↑?

Drawing inspiration from Zimmermann (2000) we will view such declarative and interrogative constructions as *lists*. Lists either consist of a *single item*, as in (1)-(3), or of *multiple items* separated by disjunction, as in (4)-(5). Moreover, we think of lists as being either *open* (signaled by a final rise), as in (2), (3) and (5), or *closed* (signaled by a final fall), as in (1) and (4).

We will formulate an account of such lists in the framework of *inquisitive semantics* (Ciardelli, Groenendijk, and Roelofsen, 2015), which derives the right interpretation for a wide range of cases in a principled way. While our focus will be on English, we expect that the basic semantic operations that our account associates with the relevant lexical, morphological, and prosodic features play a central role in the interpretation of similar constructions in other languages as well, although the division of labor between the various elements is bound to differ across languages.

A general point that we hope to establish, independently of the details of the specific account that we will propose, is that *any* account which aims to treat disjunction and the relevant prosodic features *uniformly* across declarative and interrogative constructions, has to be couched within a semantic framework that shares one of the central features of inquisitive semantics, and which sets it apart from other existing frameworks, namely a notion of meaning that encompasses both informative and inquisitive content in an integrated way. For instance, if we want to give a uniform characterization of the role of disjunction in declaratives and interrogatives, we have to specify how it affects both informative and inquisitive content, independently of the kind of construction that it happens to be part of. And similarly for the relevant prosodic features. Thus, the fact that declarative and interrogative lists are largely built up from the same parts constitutes an important piece of motivation for a semantic framework like inquisitive semantics, which treats informative and inquisitive content in an integrated way, as opposed to many previous approaches to the semantics of questions (e.g., Karttunen, 1977; Groenendijk and Stokhof, 1984), which assume a notion of question meaning that is separate from the standard truth-conditional notion of meaning that is employed for declarative sentences.

The paper is organized as follows. Section 2 provides an overview of the data that we will aim to account for and the boundary conditions that we would like our theory to satisfy, Section 3 specifies our syntactic assumptions, and Section 4 lays out our semantic framework. Finally, Section 5 spells out our account in detail, and Section **??** concludes with a brief summary and some directions for further work.

2 Overview of the empirical landscape

2.1 Prosodic characterization of the different types of lists

We take lists to differ along three basic parameters: they can be declarative or interrogative, they can be open or closed, and they can consist of one or multiple items. In total, then, we consider

$2 \times 2 \times 2 = 8$ basic types of lists, exemplified in (6)-(9).

(6) *Closed declarative lists*

a. *with a single item*: Igor speaks English↓.
b. *with multiple items*: Igor speaks English↑ or he speaks French↓.

(7) *Open declarative lists*

a. *with a single item*: Igor speaks English↑.
b. *with multiple items*: Igor speaks English↑ or he speaks French↑.

(8) *Closed interrogative lists*

a. *with a single item*: Does Igor speak English↓?
b. *with multiple items*: Does Igor speak English↑ or does he speak French↓?

(9) *Open interrogative lists*

a. *with a single item*: Does Igor speak English↑?
b. *with multiple items*: Does Igor speak English↑ or does he speak French↑?

Closed lists characteristically have falling intonation on the final item, while open lists characteristically have rising intonation on the final item. Non-final list items are canonically pronounced with rising intonation, both in open and in closed lists. Moreover, each item is pronounced in a separate intonational phrase, which means that there is an intonational phrase break after each item, before the disjunction word. In fact, two non-final list items may be separated just by an intonational phrase break, i.e., the disjunction word may be omitted if neither of the items is final.

Disjunction can be used to separate list items, but it may also occur *within* a list item. Thus, the lists in (10) below all have a single item, containing disjunction, rather than two items separated by disjunction (here, and throughout the paper, we use hyphenation to indicate the absence of an intonational phrase break):

(10) *Lists with a single disjunctive item*

a. *Closed declarative*: Igor speaks English-or-French↓.
b. *Open declarative*: Igor speaks English-or-French↑.
c. *Closed interrogative*: Does Igor speak English-or-French↓?
d. *Open interrogative*: Does Igor speak English-or-French↑?

One may wonder whether these lists could possibly also be treated as cases where disjunction still separates two list items, each a full clause, but the second clause almost entirely *elided*. Under such a view, (10a) for instance would be seen as an elliptical version of (6b), and (10c) as an elliptical version of (8b). This, however, would be incompatible with the commonplace assumption that intonational phrases align with syntactic clauses (see, e.g., Truckenbrodt, 2007; Selkirk, 2011). If the lists in (10) consisted of two full clauses, then there would have to be an intonational phrase break after the first, i.e., immediately preceding the disjunction word. Since by assumption there are no such intonational phrase breaks, the lists in (10) really have to be treated as involving a single item, which happens to contain disjunction.

Interestingly, however, there are also cases that are just like those in (10) except that they *do* exhibit an intonational phrase break right before the disjunction word. Such cases are, in so far as our assumptions up to this point dictate, structurally indeterminate. That is, they may be treated either as lists with a single item containing disjunction, or as lists with two items separated by disjunction.

Add here or somewhere elsewhere
Cases involving non-final contrastive elements, cases involving right node raising, and ones with 'discontinuous' disjunction. The prosody in such cases involves a fall/rise on contrastive elements plus at the end.

(11) *Structurally indeterminate lists*

a. *Closed declarative*: Igor speaks English↑ or French↓.
b. *Open declarative*: Igor speaks English↑ or French↑.
c. *Closed interrogative*: Does Igor speak English↑ or French↓?
d. *Open interrogative*: Does Igor speak English↑ or French↑?

Note that some types of lists that we consider here are better known under different names. For instance, singleton interrogative lists (either open or closed) are usually referred to as *polar questions* and non-singleton closed interrogative lists are usually referred to as *alternative questions*. We will sometimes use this more familiar terminology alongside our list terminology. The former has the advantage of being easier to recognize and parse; the latter has the advantage of explicating the distinctive features of each type of list and emphasizing that each specific construction is considered here as part of a more general paradigm.

Previous analyses of lists have only been concerned with some types of lists, not with the full range. Zimmermann (2000) focuses on non-singleton declarative lists like (6b), (7b), and (11a)-(11b). On the other hand, Pruitt (2007), Biezma (2009), Biezma and Rawlins (2012), and Aloni *et al.* (2013), who like us also explicitly draw inspiration from Zimmermann, focus on singleton open interrogatives (polar questions) like (9a) and (10d), and non-singleton closed interrogatives (alternative questions) like (8b) and (11c). A uniform analysis of the full range of lists exemplified in (6)-(11) would thus extend the coverage of these previous analyses considerably.[1]

2.2 Basic semantic properties to be accounted for

Our most elementary aim will be to account for the informative, inquisitive, and presuppositional content of each type of list. Most types differ from one another in at least one of these dimensions, but some actually coincide. In those cases, we will also aim to explain why one type of list has emerged as the *default* way to express the given content, while others are perceived as more *marked* forms, and sometimes trigger special discourse effects. To make this more concrete let us consider some examples. First consider the plain, non-disjunctive closed declarative in (12):

(12) Igor speaks English↓. closed declarative

In uttering this sentence, a speaker provides the information that Igor speaks English. She does not request any further information from other conversational participants, and she does not presuppose

[1] The idea that disjunction can be used to form lists has also been put forth by Simons (2001, p.616), independently of Zimmermann (2000). In Simons' work, however, this idea does not form the basis for a particular semantic treatment of disjunctive sentences and their various prosodic features, but is rather part of a pragmatic explanation for the fact that disjunctive declaratives are typically much more natural in response to a given question than truth-conditionally equivalent non-disjunctive sentences. For instance, if the question is why Jane isn't picking up the phone, then (i) is a much more natural answer than (ii).

(i) Either she isn't home, or she can't hear the phone.

(ii) It's not the case that she is at home and she can hear the phone.

To the extent that Simons' analysis of this phenomenon is successful, it provides independent motivation for our general outlook on disjunctive sentences as lists. A detailed assessment of Simons' analysis, however, is beyond the scope of this paper.

any information either. So the informative content of the sentence is non-trivial, while its inquisitive and presuppositional content are both trivial. We will say that the sentence is *informative*, but not *inquisitive* and not *presuppositional*.[2]

Now consider the open declarative in (13a), the open interrogative in (13b), and the closed interrogative in (13c):

(13) a. Igor speaks English↑. — open declarative
b. Does Igor speak English↑? — open interrogative
c. Does Igor speak English↓? — closed interrogative

In uttering any of these sentences, a speaker does not provide or presuppose any information, but does raise an issue, which may be resolved by other conversational participants either by establishing that Igor speaks English or by establishing that he doesn't speak English. Thus, these three types of sentences all have the same informative, inquisitive, and presuppositional content.[3]

Among the three, the open polar interrogative, (13b), is generally thought of as the default form to express the given content, and the other two forms are often associated with a special discourse effect: open declaratives like (13a) are taken to signal some kind of bias on the speaker's part, in this case favoring the possibility that Igor does speak English over the possibility that he doesn't (see, e.g., Gunlogson, 2001, 2008; Krifka, 2014; Malamud and Stephenson, 2015; Farkas and Roelofsen, 2017; Westera, 2017). A similar bias has also been ascribed to closed polar interrogatives like (13c) (Hedberg and Sosa, 2011), although it must be noted that the contrast between open and closed polar interrogatives has not received much consideration in the literature and more empirical work is needed before drawing any firm generalization as to whether closed polar interrogatives indeed generally signal a certain bias. In any case, we will not attempt to account for the precise nature of the possible biases associated with open declaratives and closed polar interrogatives; we will just try to explain their marked nature in comparison to open polar interrogatives (see also Farkas and Roelofsen, 2017, where this is a more central issue).

[2] We use the term 'inquisitive' here in a strong sense, i.e., we only say that a sentence is inquisitive if in uttering it, a speaker *requests* an informative response from other participants. The term is sometimes also used in a weaker sense, e.g., for sentences whose use merely *invites* an informative response (Groenendijk, 2009), or sentences whose use only requests an informative response if certain contextual conditions obtain (AnderBois, 2012). Inquisitive semantics may be used to capture the inquisitive content of sentences in these weaker senses as well (see Ciardelli *et al.*, 2012, Chapter 6, for discussion) but we will use it here only to capture inquisitive content in the stronger sense.

[3] Declarative sentences with a final rise are not always used to request information. For instance, as illustrated below, there are cases where a speaker seems to signal that she is unsure about the relevance, sufficiency, appropriateness, or clarity of her contribution, rather than to request information.

(i) A: Was John at the party?
B: Well, it was raining↑. — ⇝ not sure whether relevant (Westera, 2013a)

(ii) A: Do you speak Ladino?
B: I speak Spanish↑. — ⇝ not sure whether sufficient (Ward and Hirschberg, 1985)

(iii) A: I'm pregnant with triplets.
B: Congratulations↑. — ⇝ not sure whether appropriate (Malamud and Stephenson, 2015)

(iv) (English tourist in a French café)
I'd like... err... je veux... black coffee↑. — ⇝ not sure whether clear (Westera, 2013a)

Westera (2013a) proposes a unified account of such cases, which assumes, roughly, that the final rise signals that the speaker is not sure whether she complies with all the maxims that govern cooperative behavior in the given type of conversation. The empirical coverage of this account seems to be complementary to the proposal developed in the present paper. Namely, while Westera's theory covers cases like (i)-(iv), it does not (at least not directly) account for the fact that a final rise can render a declarative sentence inquisitive, nor for the role of the final rise versus fall in disjunctive interrogatives. The proposal in the present paper has precisely the opposite merits. For now, we assume that the rises in cases like (i)-(iv) are of a different nature than the rise that we are concerned with, although eventually we would of course like to better understand the connection between the two or even come to a fully unified theory.

Next, let us turn to the disjunctive cases. Consider first the following four instances, which are all structurally unambiguous (the others will be discussed right below):

(14) Igor speaks English-or-French↓.

(15) Does Igor speak English-or-French↑?

(16) Does Igor speak English↑ or does he speak French↑?

(17) Does Igor speak English↑ or does he speak French↓?

In uttering the declarative in (14), a speaker provides the information that Igor speaks English or French, and does not presuppose or request any further information. Thus, the sentence is not inquisitive and not presuppositional. The interrogatives in (15)-(17) on the other hand are all inquisitive. Each of them, however, expresses a different issue, i.e., differs in inquisitive content from the other two. These differences can be made more precise by considering for each sentence what kind of information is needed to *resolve* the issue that it expresses, i.e., to characterize its *resolution conditions*. In order to resolve the issue expressed by (15), a responder needs to establish that Igor speaks at least one of the two languages, or that he does not speak either. In order to resolve the issue expressed by (16), it is not sufficient to establish that Igor speaks at least one of the two languages. Rather, a responder either needs to establish that Igor speaks English, or that he speaks French. A third option, which was also available for (15), is to establish that Igor does not speak either of the two. Finally, the interrogative in (17) *presupposes* that Igor speaks one of the two languages, and resolving the issue that the sentence expresses amounts to establishing *which* of the two he speaks.[4]

Next, consider the disjunctive *declarative* in (18), which forms a minimal pair with the interrogative in (17): the two differ in clause type but have exactly the same lexical material and prosody.

(18) Igor speaks English↑ or he speaks French↓.

In uttering this sentence, a speaker provides the information that Igor speaks English or French, without requesting or presupposing any additional information. Interestingly, however, the sentence does not just convey that Igor speaks *at least* one of the two languages, but also that he does not speak both, i.e., that he speaks *exactly* one of the two. This exclusive interpretation of disjunctive declaratives is usually taken to arise as a conversational implicature (see, e.g., Grice, 1975; Gamut, 1991). However, the intonation pattern in (18) forces an exclusive interpretation even in contexts where it is not derivable as a conversational implicature. For instance, suppose we are considering whether Igor can apply for a certain fellowship. I know the requirements for the fellowship, but I don't know Igor. You know some things about Igor, but you don't know the requirements. I tell you that the candidate has to speak at least one European language, and I ask you whether Igor fulfills this requirement. You answer with (18). In this scenario it would not be possible to derive that Igor does not speak both languages as a conversational implicature, because it would not have been relevant for the purpose of the conversation for you to establish that he speaks both. Still, the implication that he does not speak both languages clearly appears to be present. Thus, it seems to arise at a semantic level, presumably as a result of the given intonation pattern. Indeed, sentences that differ minimally from (18), such as (14), would not give rise to the implication in the given scenario.

Now let us return to the alternative question in (17), which has the same intonation pattern as the declarative in (18). Interestingly, here too, it is implied that Igor speaks exactly one of the two languages. However, while in the case of the declarative this implication is part of the *at-issue*

[4]We take these differences in interpretation to be quite uncontroversial. The contrast between polar questions like (15) and alternative questions like (17) has been discussed by many authors, from Karttunen and Peters (1976) to Aloni and van Rooij (2002), Haida (2010), and Biezma and Rawlins (2012). How the interpretation of these sentences depends on their intonation has been investigated experimentally in Pruitt (2008); Pruitt and Roelofsen (2013). Open interrogatives like (16) have been discussed in Roelofsen and van Gool (2010) and Pruitt and Roelofsen (2011).

information that the sentence conveys, in the case of the alternative question it rather seems to be a *non-at-issue* implication. This is reflected by the contrast in (19)-(20) below, which shows that in the case of the declarative the implication is directly challengable using the particle *no*, while in the case of the alternative question the implication can only be challenged using particles like *actually* or *in fact*, something that is characteristic for non-at-issue implications (see, e.g., Potts, 2005; Roberts *et al.*, 2009; Anderbois *et al.*, 2015):

(19) A: Igor speaks English↑ or he speaks French↓.
B: ✓No, he speaks both. / ✓No, he doesn't speak either.

(20) A: Does Igor speak English↑ or does he speak French↓?
B: #No, he speaks both. / #No, he doesn't speak either.
✓Actually, he speaks both. / ✓Actually, he doesn't speak either.

Within the general class of non-at-issue implications, it is possible to distinguish several sub-classes. For instance, depending on the type of construction involved, non-at-issue implications may *project* in various ways (i.e., they may or may not be affected by operators that embed the construction that generates them), they may or may not place certain constraints on the context of utterance, and they may be cancellable/suspendable to various degrees (see, e.g., Roberts *et al.*, 2009). Terms like *conventional implicature*, *presupposition*, and *imposed updates* are used to refer to specific classes of non-at-issue implications, although different authors have used these terms in different ways.

The question arises, then, whether the 'exactly one' implication of alternative questions should be thought of as a conventional implicature, a presupposition, an imposed update (fixing some particular sense of each of these terms), or yet some other type of non-at-issue implication. Many authors have used the term *presupposition* (see, for instance, Haida, 2010; AnderBois, 2012; Biezma and Rawlins, 2012; Aloni *et al.*, 2013), but there are also authors who prefer to speak of *conventional implicature* (Karttunen and Peters, 1976) or *imposed updates* (Pruitt and Roelofsen, 2011). Of course, this clash of terminology does not necessarily reflect a genuine disagreement, since the terms are not always used by different authors to mean exactly the same things. We will remain agnostic as to what the most appropriate classification would be. Following most previous authors, we will refer to the 'exactly one' implication of an alternative question as a *presupposition*, but we do not thereby intend to commit to a particular standpoint on its projection behavior, the precise nature of the requirements that it places on the context of utterance, or the degree to which it can be cancelled or suspended. For some further discussion of these issues we refer to (Pruitt and Roelofsen, 2011; Biezma and Rawlins, 2012; Aloni *et al.*, 2013). Our aim here will just be to derive the presupposition in a compositional way, and to explain why the same implication surfaces as part of the at-issue informative content in the case of a declarative with the same intonation pattern.

Next, let us consider the three structurally unambiguous disjunctive cases that we did not discuss yet:

(21) Igor speaks English-or-French↑.

(22) Igor speaks English↑ or he speaks French↑.

(23) Does Igor speak English-or-French↓?

The empirical status of these cases is less clear than that of (14)-(18). For each of these sentences, it is in fact difficult to imagine a context in which it would be used, let alone a context in which it would be the *prefered* way of expressing something. We will aim to account for this intuition, i.e., to derive that each of these sentences expresses something that is better conveyed by one of the sentence types exemplified in (14)-(18), where 'better' either means that the construction as such is more economical, or that the chances of being interpreted as intended are greater.

We also aim to account for a more specific finding concerning sentences like (23) from an experiment reported in Pruitt and Roelofsen (2013) (this finding can be accounted for but the account is not included yet in the present manuscript). In the experiment, participants were asked to listen to a disjunctive question and to choose between two possible paraphrases, or provide their own paraphrase if they did not find either of the two given paraphrases accurate. The question either had the canonical prosody of a disjunctive polar question, as in (15), or that of an alternative question, as in (17), or a mix of these two patterns, resulting either in the prosody of an open question, as in (16), or in the prosody of (23). The paraphrase options were as follows:

(24) a. Which of these languages does Igor speak: English or French?
b. Does Igor speak any of these two languages: English or French?
c. Other: ...

The first paraphrase was intended to capture the interpretation of an alternative question, and indeed, with the canonical prosody of an alternative question this paraphrase was selected 92% of the time. The second paraphrase is compatible with a polar question interpretation and with an open question interpretation, but certainly not with an alternative question interpretation (it does not imply that Igor speaks exactly one of the two languages); and indeed, with the canonical prosody of a polar question this paraphrase was selected 89% of the time, and with the prosody of an open question it was selected 83% of the time. Now, what about questions with the prosody exemplified in (23), i.e., ones that exhibit a final fall, just like alternative questions, but consist of a single intonational phrase, just like polar questions? For such questions, the first paraphrase, i.e., the one corrsponding to an alternative question, was selected 82% of the time.[5] Thus, our theory should not just explain why it is difficult to imagine a context in which a question with the intonation pattern of (23) would be the prefered way of expressing a given meaning, but also why, if listeners are presented with such a question after all, they predominantly interpret it as an alternative question (at least in the absence of any contextual cues that might favor a different interpretation).

2.3 Structurally indeterminate cases

The basic structurally indeterminate cases are repeated below.

(25) Igor speaks English↑ or French↓. — closed declarative

(26) Igor speaks English↑ or French↑. — open declarative

(27) Does Igor speak English↑ or French↓? — closed interrogative

(28) Does Igor speak English↑ or French↑? — open interrogative

While the prosody of these sentences does not fully determine whether they should be treated as lists with a single item containing disjunction or as lists with two items separated by disjunction, in conversation they seem to behave much more like the latter. To see this, let us look more closely at each case in turn.

First, consider the structurally indeterminate closed declarative in (25) in comparison with the explicitly bi-clausal closed declarative in (29a) and the mono-clausal one in (29b).

(29) a. Igor speaks English↑ or he speaks French↓. — bi-clausal
b. Igor speaks English-or-French↓. — mono-clausal

The structurally indeterminate (25) behaves like (29a), and not like (29b). In particular, just like (29a) and unlike (29b), (25) implies that Igor speaks *exactly* one of the two languages even in scenarios in which this implication cannot be derived as a conversational implicature (recall the example discussed on page 7 where Igor needs to speak at least one European language in order to apply for a certain scholarship).

[5] In all cases, there were hardly any instances where participants provided their own paraphrase rather than selecting one of the given paraphrases.

The case of the open declarative in (26) is a bit different, because this sentence is highly marked—it is difficult to imagine any context in which it could be felicitously used. Compare this with the explicitly bi-clausal open declarative in (30a) and the mono-clausal one in (30b).

(30) a. Igor speaks English↑ or he speaks French↑. — bi-clausal
b. Igor speaks English-or-French↑. — mono-clausal

It seems that (30a) has the same highly marked status as (26): again, it is difficult to imagine any context in which this sentence could be felicitously used. On the other hand, while (30b) is certainly marked as well, it *is* possible in this case to imagine scenarios in which it could be felicitously used. Consider the following.

(31) A: Old Igor wants to travel to Europe, but he doesn't speak any European language. How will he survive?
B: I heard that he actually does speak some English or French, from his navy years.
A: Igor speaks English-or-French↑.
B: Yes, that's what I heard.

Note that neither the structurally indeterminate (26) nor the explicitly bi-clausal (30a) could be used in this scenario. Thus, even though it is not so clear what the semantic interpretation of (26) should be taken to be, it can still be seen to exhibit the behavior of a bi-clausal list rather than that of a mono-clausal one.

Next, consider the structurally indeterminate closed interrogative in (27) in comparison with the explicitly bi-clausal one in (32a) and the mono-clausal one in (32b).

(32) a. Does Igor speak English↑ or does he speak French↓? — bi-clausal
b. Does Igor speak English-or-French↓? — mono-clausal

Both (27) and (32a) are invariably interpreted as alternative questions, presupposing that Igor speaks exactly one of the two languages and eliciting a response that establishes which of the two it is. The mono-clausal interrogative in (32b) on the other hand, has a marked status.

Finally, consider the structurally indeterminate open interrogative in (28), in comparison with the explicitly bi-clausal one in (33a) and the mono-clausal one in (33b).

(33) a. Does Igor speak English↑ or does he speak French↑? — bi-clausal
b. Does Igor speak English-or-French↑? — mono-clausal

Again, the structurally indeterminate list patterns with the bi-clausal one: in order to resolve the issue that it expresses it is not sufficient to establish that Igor speaks one of the listed languages; rather, it needs to be established which of the two languages he speaks (or else that he does not speak either). On the other hand, in order to resolve the issue expressed by the mono-clausal interrogative in (33b) it *is* sufficient to establish that Igor speaks one of the two listed languages, without necessarily specifying which of the two.

The general pattern that seems to emerge, then, is that structurally indeterminate lists behave much more like bi-clausal lists than like mono-clausal ones.This does not necessarily mean, of course, that our syntax should only allow for these sentences to be parsed as bi-clausal lists, i.e., that the presumed structural ambiguity should be eliminated altogether. Even if the syntax allows for multiple parses, the semantics may be able to explain the prevalence of a particular interpretation. And if this can be done in a principled way, the explanatory value of the theory as a whole would be significantly enhanced.

Moreover, besides this theoretical consideration there is also an empirical reason why the syntax should not force us to parse structurally indeterminate lists as bi-clausal ones. Namely, if we look at cases in which disjunction interacts with another scope-taking element, we find that structurally indeterminate lists do *not* always pattern with explicitly bi-clausal ones (though even in these cases they still behave differently from mono-clausal lists).

To see this, compare the following closed declaratives:

(34) a. Every second grade student takes English↑ or French↓. — indeterminate
b. Every second grade student takes English-or-French↓. — mono-clausal
c. Every second grade student takes English↑ or every second grade student takes French↓. — bi-clausal

On its most salient reading, the structurally indeterminate list in (34a) implies that every second grade student takes *exactly* one of the two subject, none of them took both. This contrasts with the mono-clausal list in (34b) which just implies that every second grade student takes *at least* one of the two subjects, perhaps both. But it clearly also contrasts with the bi-clausal list in (34c) which implies that exactly one of the two subjects was taken by every second grade student; though some of the students may have taken the other subject as well. This reading is available for (34a) as well; it can be made more salient by adding "I don't remember which". However, the important observation is that (34a) also has a reading of its own, one that it does not share with (34b) or (34c).

Let us see whether this contrast arises with the other types of lists as well. First consider the case of closed interrogatives:

(35) a. Does every second grade student take English↑ or French↓? — indeterminate
b. Does every second grade student take English-or-French↓? — mono-clausal
c. Does every second grade student take English↑ or does every second grade student take French↓. — bi-clausal

Interestingly, here we see that the indeterminate list patterns with the bi-clausal list again: both are unambiguously interpreted as alternative questions. So even in the structurally indeterminate list, disjunction can only be interpreted as taking scope over the quantifier in subject position. This contrasts with the mono-clausal list in (35b), which despite its marked status clearly seems to have a polar question reading, on which disjunctions scopes below the quantifier. Thus, the divergence between indeterminate lists and bi-clausal lists that we found in the case of closed declaratives does not manifest itself in the case of closed interrogatives.

Next, consider the case of open declaratives:

(36) a. Every second grade student takes English↑ or French↑. — indeterminate
b. Every second grade student takes English-or-French↑. — mono-clausal
c. Every second grade student takes English↑ or every second grade student takes French↑. — bi-clausal

We already saw above that, even with a simple proper name in subject position, such constructions are very marked. Inserting a quantifier in subject position certainly does not help. It still seems, though, that the indeterminate list patterns with the bi-clausal one in that it is difficult to imagine any context in which it could be felicitously used. For the mono-clausal list in (36b) it does seem possible to think of such contexts, along the lines of the scenario in (31) above. In any case, what we do *not* find here is a divergence between the indeterminate and the bi-clausal list, as we did in (34).

Finally, consider the case of open interrogatives:

(37) a. Does every second grade student take English↑ or French↑? — indeterminate
b. Does every second grade student take English-or-French↑? — mono-clausal
c. Does every second grade student take English↑ or does every second grade student take French↑. — bi-clausal

Here the judgments are again not as clear, but again there does not seem to be a significant contrast between the indeterminate list and the bi-clausal one. Both seem to request a response that establishes for one of the subjects that it is taken by every student, or else that this not hold for either subject. The mono-clausal list on the other hand, is clearly interpreted as a polar question, requesting a response that establishes whether or not one of the subjects was taken by every student, without necessarily specifying which of the two.

In sum, only in the case of closed declaratives do we find a clear difference in interpretation between structurally indeterminate lists and explicitly bi-clausal lists. Our theory will have to account both for the fact that such a difference can in principle arise, and for the fact that it only does arise in a rather restricted class of examples.

2.4 Missing readings

Some of the readings that we have discussed so far, as well as the associated intonation patterns, are systematically blocked in certain configurations. We will briefly discuss some of the relevant cases below; more data will be brought into the picture as we will develop, test, and compare our theory to previous accounts of these observations (especially Larson, 1985; Han and Romero, 2004a; Beck and Kim, 2006).

Either. If a disjunctive question is phrased with *either... or* rather than with plain *or*, it can only receive a polar question interpretation, not an alternative or open question interpretation.

(38) Does Igor speak either English or French? ✓polar *alt *open

Trying to force an alternative or open question interpretation by means of intonation leads to ungrammaticality / uninterpretability.

(39) *Does Igor speak either ENGLISH↑ or FRENCH↓? *alt

(40) *Does Igor speak either ENGLISH↑ or FRENCH↑? *open

Accentuation. If a disjunctive question has a prominent pitch accent on an element that is not a contrastive element in one the disjuncts, then it can again only be interpreted as a polar question, not as an alternative question or as a polar question (the fact that alternative question interpretations are blocked in this case has been discussed in detail by Han and Romero 2004a and Beck and Kim 2006; our account will be compared to theirs in Section 5.6.2).

(41) Did Peter only introduce BILL↑ to-Sue-or-to-Mary↑? ✓polar *alt *open

Again, trying to force an alternative or open question interpretation by means of intonation leads to ungrammaticality / uninterpretability.

(42) *Did Peter only introduce BILL↑ to SUE↑ or to MARY↓? *alternative question

(43) *Did Peter only introduce BILL↑ to SUE↑ or to MARY↑? *open question

Finally, notice that it is really the prominent pitch accent on *Bill* that causes the problem; without this pitch accent, (42) and (43) can be interpreted straightforwardly as an alternative question and an open question, respectively.

(44) Did Peter only introduce Bill to SUE↑ or to MARY↓? ✓alternative question

(45) Did Peter only introduce Bill to SUE↑ or to MARY↑? ✓open question

Islands. Larson (1985) observed that sentences like (46) cannot be interpreted as alternative questions. Again, open question interpretations do not seem to be available either in such cases.

(46) Do you believe the claim that Bill resigned or retired? ✓polar *alt *open

Larson pointed out that the lack of an alternative question interpretation can be explained in terms of familiar constraints on *wh*-movement, under the assumption that alternative questions always involve movement of an operator from the edge of the disjunctive phrase to spec-CP. The fact that (46) does not admit an alternative question interpretation would then be explained by the same constraints on movement that explain the ungrammaticality of (47):

(47) *What do you believe the claim that Bill did?

Han and Romero (2004b) endorse this argument, but Beck and Kim (2006) argue against it, based on examples like (48).

(48) Do you need a person who speaks Dutch or German? ✓alt ✓open

On Larson's account, such examples are wrongly predicted not to admit an alternative question interpretation, because the corresponding *wh*-construction is ungrammatical:

(49) *What do you need a person who speaks?

Beck and Kim conclude that the movement account of (46) cannot be right. However, they do not really provide an alternative account of (46), and the debate concerning these types of examples is still open (see also Biezma and Rawlins, 2012, for an overview of the different standpoints).

We will suggest a new perspective on these cases, on which the availability of alternative and open question interpretations is not primarily governed by constraints on movement, but rather by constraints on *ellipsis*. An empirical observation that points in this direction is the fact that the contrast between Larson's example, (46), and that of Beck and Kim, (48), is also found in the domain of *fragment answers*:

(50) A: Do you believe the claim that John resigned?
B: *No, retired.

(51) A: Do you need someone who speaks Dutch?
B: No, German.

We will show that the parallelism between alternative/open questions and fragment answers extends to other cases as well, leading to the general hypothesis that the formation of alternative and open questions requires the kind of ellipsis that is also involved in the formation of fragment answers. We will not be able to present a full account of the constraints on this kind of ellipsis here, but hope that the new theoretical perspective and the new empirical observations that we will offer will at least constitute a fruitful step towards such an account.

Add here or somewhere elsewhere

Clausal disjunction. There are also cases where a polar question interpretation is blocked, forcing an alternative or open question interpretation. These are cases in which disjunction has two full interrogative clauses as its arguments, as in (52).

(52) Does Igor speak English, or does he speak French? *polar

Note that this sentence can be interpreted either as an alternative question or as an open question, depending on whether the second disjunct is pronounced with a fall or with a rise. But there is no way of pronouncing the sentence that yields a polar question interpretation.

Negative polarity items. Finally, there are cases where only alternative question interpretations are blocked, while polar and open question interpretations are available. These are cases involving negative polarity items (NPIs), like (53) and (54).

(53) Does anyone in this room speak English or French? *alt ✓polar ✓open

(54) Has Igor ever been to England or France? *alt ✓polar ✓open

Interestingly, in the case of an explicitly bi-clausal interrogative list with an NPI in each clause, the alternative question interpretation is still blocked, and the open question interpretation is the only one left. Trying to force an alternative question interpretation by means of intonation results in ungrammaticality.

(55) Has Igor ever been to England↑, or has he ever been to France↑? *alt *polar ✓open

(56) *Has Igor ever been to England↑, or has he ever been to France↓? *alt *polar *open

The fact that NPIs block alternative question readings will play a role in the development of our theory, in particular in motivating our syntactic assumptions. Vice versa, our theory may also shed some new light on this phenomenon. However, a full account is beyond the scope of the paper, as it would force us to dive too deep into the manifold intricacies of NPIs and the various ways of accounting for their distribution and interpretation. We refer to Nicolae (2013) and Guerzoni and Sharvit (2014) for extensive discussion for NPIs in questions (although open question interpretations are not taken into consideration in these works and seem to present an interesting challenge).

2.5 Restricted distribution of exclusive strengthening

We have seen that, in the presence of a certain intonation pattern, both declarative and interrogative disjunctive lists signal that *exactly* one of the disjuncts is supposed to hold.

(57) Igor speaks English↑ or French↓. $\rightsquigarrow$ exactly one of the two (at-issue)

(58) Does Igor speak English↑ or French↓? $\rightsquigarrow$ exactly one of the two (presupposed)

We also noted that there is a difference between the two cases, namely that in the case of a declarative the implication is part of the at-issue informative content, while in the case of an interrogative it is a presupposition. Let us for the moment disregard this difference and concentrate on what the two cases have in common. It seems that, one way or another, the given intonation pattern imposes some sort of 'exclusive strengthening' operation on the disjunction. One question that arises, then, is whether this prosodically marked exclusive strengthening operation can apply to *any* type of disjunction, or whether it can apply only under certain conditions, i.e., in certain syntactic/semantic environments.

The first thing we may check is whether the relevant strengthening operator can only apply to matrix disjunctions, or also to disjunctions that are interpreted in the scope of another operator. The following examples show that the latter is the case.

(59) Every second grade student in this school takes Spanish↑ or Chinese↓.

(60) Susan always spends her holidays in Greece↑ or in Italy↓.

(61) Peter believes that Igor speaks English↑ or French↓.

For instance, (60) is most naturally interpreted as saying that whenever Susan goes on holidays, she either goes to Greece or to Italy, not to both. It also has a reading that results from disjunction taking wide scope, which can be made salient by adding "I don't remember which". On this reading is says that Susan either always goes to Greece, or she always goes to Italy. In this case the implication that arises from by exclusive strengthening is very weak, namely that Susan does not always go to both. The important observation, however, is that exclusive strengthening, as marked by the relevant intonation pattern, is not only a root phenomenon: it may occur in the scope of operators like *every*, *always*, and *believe*.

The next observation, though, is that it may not occur in the scope of just *any* operator. Crucially, all the operators that scope over disjunction in the examples above are *upward monotonic*. In the scope of a *downward monotonic* or *non-monotonic* operator, prosodically marked exclusive strengthening is not licensed.[6]

(62) No second grade student in this school takes Spanish↑ or Chinese↓. *narrow scope disj

(63) Susan never spends her holidays in Greece↑ or in Italy↓. *narrow scope disj

(64) Peter doubts that Igor speaks English↑ or French↓. *narrow scope disj

(65) Exactly five students in this school take Spanish↑ or Chinese↓. *narrow scope disj

The only interpretation that these sentences admit, with the given intonation pattern, is one where the disjunction takes wide scope (again, this reading can be made salient by adding "I don't remember which"). In other downward monotonic environments, such as the antecedent of a conditional or the restrictor of *every*, prosodically marked exclusive strengthening of a disjunction results in plain ungrammaticality, presumably because a wide-scope reading is unavailable for independent reasons.

(66) *If Susan goes to Greece↑ or to Italy↓, I will join her.

(67) *Everyone in Greece↑ or in Italy↓ speaks some English.

Next, let us turn to questions. Now that we know that prosodically marked exclusive strengthening is not just a root phenomenon, it becomes a non-trivial observation that in a question the relevant prosody, if licensed, *always* yields an alternative question interpretation. For instance, (58) cannot be interpreted as a polar question asking whether it is true that Igor speaks exactly one of the two languages; rather, it has to be interpreted as an alternative question, asking which of the two languages he speaks. This shows that whichever operator is involved in the formation of polar questions, it is one that, just like the various downward monotonic and non-monotonic operators considered above, does not license prosodically marked exclusive strengthening in its scope. Indeed, if we force a polar question interpretation by using *either. . . or* rather than just *or*, we see that the relevant intonation pattern results in ungrammaticality (an observation also made by Nicolae, 2013; Guerzoni and Sharvit, 2014).

(68) *Does Igor speak either English↑ or French↓?

Importantly, it is not the *either. . . or* construction itself that is incompatible with the relevant prosody, or its semantic effect, because the two can happily co-exist in declarative constructions:

(69) Igor speaks either English↑ or French↓.

We conclude from this that the clash in (68) is really one between the operation that is involved in the formation of a polar question and the prosodically marked exclusive strengthening operator.

[6] There is another way of prosodically marking exclusive strengthening of disjunctions, which involves major emphasis on the disjunction word itself (e.g., English OR French) (see, e.g., Fox and Spector, 2015). As illustrated below, this type of prosodically marked exclusive strenghtening *is* licensed in the scope of downward monotonic and non-monotonic operators.

(i) No second grade student in this school takes Spanish OR Chinese.
(. . . Most of them take both, some don't take either.)

(ii) Exactly five students in this school take Spanish OR French.
(. . . Most of the others take both, some don't take either.)

We will not be concerned with this type of prosody on disjunction. Whenever we speak of prosodically marked exclusive strengthening we are concerned with the kind of prosody exemplified in (57)-(58).

Add here or somewhere elsewhere
Note that disjunction necessarily takes widest scope in alternative questions, e.g., in:

(70) Does every second grade student in this school take Spanish↑ or Chinese↓?

(71) Does Susan always spend her holidays in Greece↑ or in Italy↓?

(72) Does Peter believes that Igor speaks English↑ or French↓?

Note that this is not the case in closed declaratives with the same intonation pattern. Perhaps this should go in the section of structurally indeterminate cases?

Of course, all these observations concerning the restricted distribution of prosodically marked exclusive strengthening are reminiscent of restrictions on the distribution of NPIs (Ladusaw, 1980; Kadmon and Landman, 1993; Chierchia, 2013, among many others). Interestingly, though, the distribution of exclusive strengthening and NPIs is quite complementary: roughly speaking, NPIs are licensed in downward monotonic environments and in polar questions, while exclusive strengthening is licensed in upward monotonic environments, and not in polar questions. Neither NPIs nor exclusive strengthening are licensed in non-monotonic environments.

The account that we will develop of the distribution of exclusive strengthening will nevertheless heavily build on insights from the literature on NPIs. In particular, it will draw on Kadmon and Landman's idea that NPIs are licensed only if their 'domain widening effect' strengthens the overall semantic content of the sentence, where strength is measured in terms of entailment. Roughly, we will propose that prosodically marked exclusive strengthening is also licensed only if it strengthens the overall semantic content of the sentence. Interestingly, we will see that this constraint accounts for the distribution of prosodically marked exclusive strengthening both in declaratives and in interrogatives, provided that strength is measured in terms of *inquisitive entailment* rather than classical entailment.

2.6 Embedded lists

Thus far, we have considered only unembedded declarative and interrogative lists, and these will also be our main focus in this paper. However, lists can also be embedded. In this case, the correlation between prosody and interpretation is not as clearcut, presumably because the realization of the relevant prosodic features may be affected, or perhaps in some cases completely 'overruled' by the realization of prosodic features associated with the matrix list. To illustrate this, consider the following example:

(73) Maria knows whether Igor speaks English or French.

The embedded interrogative can receive a polar question interpretation, under which the sentence as a whole conveys that Maria either knows that Igor speaks one of the two languages, or that she knows that he does not speak either of them, whichever of these two possibilities is actually the case. But the embedded interrogative can also receive an alternative question interpretation, under which the sentence as a whole presupposes that Igor speaks exactly one of the two languages and conveys that Maria knows which of the two he speaks. Importantly, if (73) is pronounced with a 'neutral' intonation pattern, these two interpretations are *both* available, i.e., intonation does not disambiguate as strongly here as it does in the case of unembedded lists. As mentioned above, this is presumably due to the fact that the realization of the prosodic features of the embedded list interacts with—or may even be completely overruled by—the realization of the prosodic features of the matrix list.

This said, there is one striking observation to make, which is that *declarative* embedded lists never seem to be interpreted as *open* lists. To see this consider the following two examples:

(74) Maria knows that Igor speaks English↑.

(75) Maria knows that Igor speaks English↓.

Let us first look at (74), which has a final rise. This rise could in principle pertain either to the embedded declarative list, or to the matrix declarative list. The only available interpretation, however, is one where it pertains to the matrix list. Under this interpretation, the sentence raises an issue which can be resolved either by establishing that Maria knows that Igor speaks English or by establishing that she doesn't know that Igor speaks English. If the embedded list were to be interpreted as an open list, then the sentence as a whole would convey that Maria has enough information to resolve the issue whether Igor speaks English or not. This reading is clearly not available.

Next, let us turn to (75), which has a final fall. Given what we remarked above about the limited realization of prosodic features of embedded lists due to interaction with the realization of prosodic features of the matrix list, it may be expected that, even though there is no final rise on the embedded list in (75), it may still be an open list. Again, however, such an interpretation is not available. Thus, it seems that embedded declaratives are simply never interpreted as open lists.

What about embedded interrogatives? Can they be interpreted as open lists? Here the situation is not so clear. Consider (73) for instance. If the embedded interrogative in this sentence is interpreted as an open list, then the sentence as a whole implies that Maria knows one of three things: (i) that Igor speaks English, (ii) that he speaks French, or (iii) that he doesn't speak either of the two. It is difficult to say whether this reading is available or not, because on the one hand, in any situation in which the sentence would be true under this reading, it would also be true under one of the two readings described above, which result from interpreting the embedded list as a polar or as an alternative question; and on the other hand, in any situation in which the sentence would be false under the open reading, it would again also be false either under the polar or under the alternative reading.

The same is true for many other examples involving embedded interrogatives. However, there are some cases which seem to suggest that an open interpretation in principle *is* available for embedded interrogatives. Such cases involve predications like "I wonder" and "I want to know", as illustrated in (76) and (77).

(76) I wonder whether Igor speaks English↑ or French↑.

(77) I want to know whether Igor speaks English↑ or French↑.

In uttering one of these sentences, with the indicated intonation pattern, a speaker does not signal that she is presupposing that Igor speaks one of the two languages. This rules out an alternative question interpretation for the embedded interrogatives. On the other hand, the speaker does seem to indicate that, if Igor does happen to speak one of the two languages, she would like to know *which* of the two he speaks. That is, she would not be satisfied with an answer that just establishes that he speaks either of the two. She is looking for more specific information. This suggests that the embedded interrogatives are indeed interpreted as open questions in these examples, and not as polar questions.

Thus, we tentatively conclude that embedded interrogatives *can* in principle be interpreted as open lists, which means in particular that open lists are not a pure matrix phenomenon. One thing that our theory should explain, then, is why embedded *declaratives* can*not* be interpreted as open lists.

2.7 Redundancy

Hurford (1974) suggested, based on examples like those in (78) below, that disjunctions where one disjunct entails another are infelicitous, a generalization that has been referred to in subsequent literature as *Hurford's constraint*.

(78) a. *John is American or Californian.
b. *That painting is of a man or a bachelor.
c. *The value of x is different from 6 or greater than 6.

Simons (2001), Katzir and Singh (2013) and Meyer (2014) offer a natural explanation in terms of *redundancy*: a Hurford disjunction is inevitably equivalent with one of its disjuncts, rendering the other disjunct, and the disjunction operation as such, redundant.

However, Hurford (1974) himself, and especially Gazdar (1979), already identified many apparent counterexamples to Hurford's constraint, such as those in (79).

(79) a. Mary will bring WINE↑, or JUICE↑, or BOTH↓.
b. Mary read most of these books, or all of them.
c. John and Mary have three kids, or four.

Chierchia *et al.* (2009, 2012), Katzir and Singh (2013) and Meyer (2014) suggest that these examples may be seen as evidence for the hypothesis that in reconstructing the logical form of a given sentence, an interpreter may in principle insert an *exhaustive strengthening* operator at any node, which when applied to a constituent X, roughly speaking negates every scalar/focus alternative for X that is stronger than X itself. For instance, when applied to 'Mary will bring JUICE', with focus on 'JUICE', it yields 'Mary will *only* bring JUICE', and when applied to 'Mary read most of these books', with the scalar item 'most', it yields 'Mary read most-but-not-all of the books'. If such an operator is indeed part of the grammar, the contrast between the examples in (78) and those in (79) can be given a principled explanation: Hurford's constraint holds without exceptions, due to a general ban on redundancy, but in some cases the constraint is obviated by exhaustive strengthening of the weaker disjunct, in such a way that it is no longer redundant.[7]

While the literature on Hurford's constraint has been predominantly concerned with disjunctions in *declarative* sentences, it has been noted in Ciardelli and Roelofsen (2017) that essentially the same patterns are found in disjunctive *questions* as well. For instance, the alternative question in (80) below is just as infelicitous as Hurford's declarative (78a), and (81) is as felicitous as its declarative counterpart (79a).

(80) *Is John AMERICAN↑, or CALIFORNIAN↓?

(81) ✓Will Mary bring WINE↑, or JUICE↑, or BOTH↓?

Clearly, one would hope that these observations could be explained by the same general principles that have been proposed to explain the original observations, namely, a ban against redundant operations and the availability of local exhaustive strengthening as a way of obviating such redundancy. However, as pointed out in Ciardelli and Roelofsen (2017), whether this explanation carries over crucially depends on the way that disjunction is taken to operate in forming alternative questions. The literature on Hurford disjunctions in declarative sentences generally assumes a classical, truth-conditional treatment of disjunction, which is clearly not suitable to capture its role in alternative questions. Rather, to account for disjunction in alternative questions we will need to characterize its contribution to the *resolution/answerhood* conditions of the constructions that it is part of. In-

[7] This account has been further refined by Fox and Spector (2015), who propose certain restrictions on the distribution of the exhaustive strengthening operator in order to account for a number of further empirical issues concerning Hurford disjunctions put forth by Singh (2008) and Gajewski and Sharvit (2012). These refinements will not be directly relevant for our purposes, however, and will therefore not be considered explicitly.

corporating insights from Ciardelli and Roelofsen (2017), we will aim to do this in such a way that the 'redundancy plus exhaustification' account of Hurford disjunctions in declarative sentences can be straightforwardly extended to the domain of disjunctive questions as well.

2.8 Polarity particle responses

A final empirical challenge concerns the distribution and interpretation of *polarity particles* (*yes*/*no*) in response to the various types of lists. For instance, there is a well-known contrast between polar and alternative questions: the former license polarity particle responses while the latter don't.

(82) *Context: Amalia wants to know whether Igor qualifies for a certain fellowship, for which he needs to speak either English or French.*

Does he speak English-or-French↑?

a. ✓ Yes. / ✓ Yes, he speaks English. / ✓ Yes, he speaks French.
b. ✓ No. / ✓ No, he only speaks Russian.

(83) *Context: Amalia wants to write a letter to Igor. She knows that he speaks either English or French, but she doesn't remember which.*

Does he speak English↑, or French↓?

a. #Yes. / #Yes, he speaks English. / #Yes, he speaks French.
b. #No. / #No, he doesn't speak either. / #No, he speaks both.

Interestingly, open questions fall somewhere in between: they do not license 'bare' *yes* responses, but bare *no* responses are fine and *yes* is also acceptable if accompanied by a phrase that explicitly confirms one of the disjuncts.

(84) *Context: Amalia wants to write a letter to Igor, who is Russian. She doesn't speak Russian, so she would like to know whether Igor speaks any other languages that she could write in.*

Does he speak English↑, or French↑?

a. #Yes. / ✓ Yes, he speaks English. / ✓ Yes, he speaks French.
b. ✓ No. / ✓ No, he only speaks Russian.

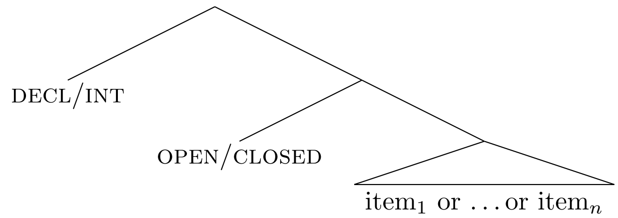
There are many other interesting empirical facts concerning polarity particle responses (see, e.g., Kramer and Rawlins, 2011; Holmberg, 2013; Krifka, 2013; Roelofsen and Farkas, 2015). Polarity particle responses to *disjunctive* questions and assertions have been considered in quite some detail in Roelofsen and Farkas (2015). We won't spell out an explicit account in this paper, but will make sure that the account of lists that we develop here is compatible with the account of polarity particle responses proposed in Roelofsen and Farkas (2015). We will briefly sketch how the two can be combined in Section 5.10.

This concludes our overview of the data that we will aim to account for and the 'boundary conditions' that we want our theory to satisfy. We are now ready to begin laying out our account, starting with the syntactic component.

3 Syntactic assumptions

3.1 The structure of lists

Schematically, we assume that a list with n items has the following syntactic structure:



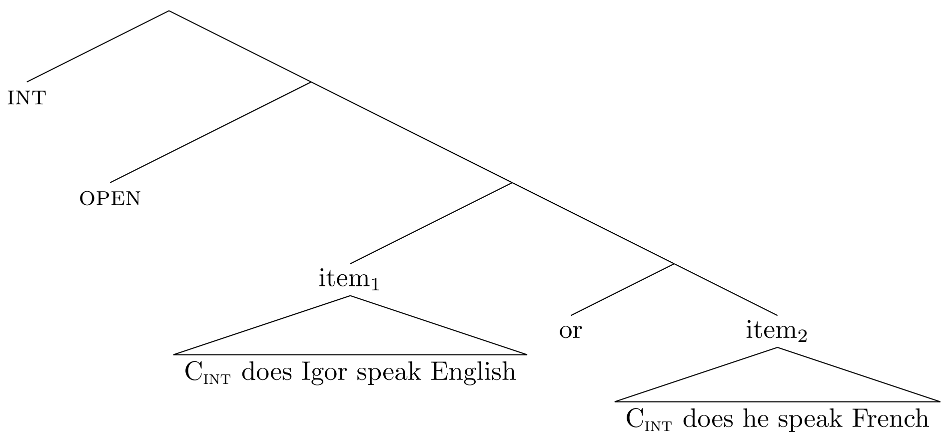
We will refer to DECL/INT and OPEN/CLOSED as *list classifiers*, and to the rest of the structure as the *body* of the list. We assume that each item in the body of the list is a full clause, headed by a declarative or interrogative complementizer, C_{DECL} or C_{INT}, depending on whether the list is classified as DECL or INT, respectively. To illustrate this, consider the following three cases:

(85) Does Igor speak English↑ or does he speak French↑?

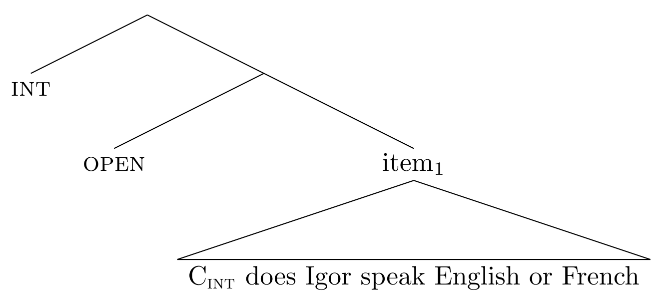
(86) Does Igor speak English-or-French↑?

(87) Igor speaks English↓.

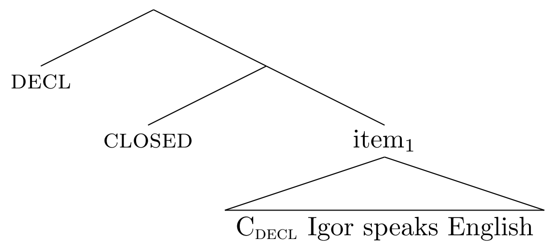
We view (85) as an open interrogative list with two items. Thus, it is taken to have the following logical form:



On the other hand, we view (86) as an open interrogative list with a *single* item, containing a disjunction. Thus, this sentence is taken to have the following logical form:



Finally, (87) is a closed declarative list with a single item, which is taken to have the following logical form:



Now, to illustrate how structural differences are supposed to affect the way in which a given sentence is pronounced, consider the following 'surface string' which admits various logical forms, each corresponding to a different intonation pattern.

(88) Does Igor speak English or French?

According to the syntactic assumptions that we have made so far, the sentence can be assigned the following four logical forms (below we will add an intonational morpheme responsible for exclusive strengthening, which will result in even more possible logical forms for the same sentence—though most of these will eventually be ruled out on semantic grounds):[8]

(89) a. [INT [OPEN [C_{INT} does Igor speak English or French]]]
b. [INT [OPEN [[C_{INT} does Igor speak English] or [C_{INT} does Igor speak French]]]]
c. [INT [CLOSED [C_{INT} does Igor speak English or French]]]
d. [INT [CLOSED [[C_{INT} does Igor speak English] or [C_{INT} does Igor speak French]]]]

Let us point out how the structural differences between (89a)-(89d) are supposed to affect the way in which (88) is pronounced. If (88) consists of two interrogative clauses, as in (89b)/(89d), then each of these clauses will be contained in a separate intonational phrase. This means, in particular, that there will be a pause before the disjunction word, indicating an intonational phrase boundary. Moreover, if (88) consists of two full interrogative clauses, then it follows from independent principles concerning the syntactic encoding of information structure[9] that the contrastive elements in these two clauses, *English* and *French*, must be marked as contrastive foci, and phonologically such contrastive foci must receive pitch accents.

On the other hand, if (88) consists of a single interrogative clause, as in (89a)/(89c), then the disjunctive phrase will be contained in a single intonational phrase. This means that, other things being equal, there will be no pause before the disjunction to indicate an intonational phrase boundary, because there is no such boundary, and moreover, there will not necessarily be a need to mark the disjuncts as contrastive foci, which means that they will not necessarily receive separate pitch accents.

Thus, the structural differences between (89a)/(89c) on the one hand and (89b)/(89d) on the other result in differences in phrasing and accentuation, for reasons that are independent of the specific construction considered here. Besides these structural differences, there is another source of variation in prosody as well, namely (89a-b) are classified as OPEN lists while (89c-d) are classified as CLOSED lists. As anticipated, we take it that this results in a different pitch contour on the final list item: if the logical form of (88) is (89a) or (89b), with the OPEN classifier, then it will be pronounced with a final rise; if its logical form is (89c) or (89d), with the CLOSED classifier, then it will be pronounced with a final fall.

[8] We assume here that ellipsis is licensed in structures like (89b) and (89d), to yield a surface string like (88). We will provide motivation for this assumption in Section ??.

[9] Reference, Selkirk and Kratzer / Buring?

3.2 Exclusive strengthening

We will assume the existence of an intonational morpheme, denoted as E, which is responsible for exclusive strengthening of disjunctions. We assume that E can in principle be attached to any disjunction, no matter whether it is a disjunction of two full clauses or a disjunction of smaller constituents. In Section 4.4 we will discuss the semantic interpretation of E in detail, and in Section 5.4 we will argue that E is only licensed if its presence really strengthens the semantic content of the construction that it is part of. For now, we just focus on how the presence of E affects the prosody of a disjunction. Intuitively speaking, we take it that in the presence of E, the two disjuncts are pronounced in a way that marks them as contrastive alternatives. Think of phrases like 'now or never', 'take it or leave it'. More formally, we assume that E makes sure that the disjuncts are marked as contrastive foci, which means that they will both receive pitch accents, and moreover, it makes sure that the first (and possibly intermediate) disjuncts are pronounced with a rise,[10] while the last is pronounced with a fall.

To illustrate, consider first the following two logical forms, which only differ in the absence/presence of E:

(90) a. [DECL [CLOSED [C_{DECL} every second grade student here takes [English or French]]]]
b. [DECL [CLOSED [C_{DECL} every second grade student here takes [E [English or French]]]]]

These logical forms correspond to the following intonation patterns, respectively:

(91) a. Every second grade student here takes English or French↓.
b. Every second grade student here takes ENGLISH↑ or FRENCH↓.

Note that in both cases there is a final fall: even if E is not present, this is ensured by CLOSED. However, in addition to a final fall, (91b) also has contrastive pitch accents of both disjuncts, and rising intonation on the first. This is due to the presence of E, and semantically this correlates with an exclusive interpretation of the disjunction (again, something we will return to in detail in Section 4.4).

Now consider the logical forms in (92) below, which again only differ in the absence/presence of E. In this case, however, both disjuncts are full declarative clauses.

(92) a. [DECL [CLOSED [C_{DECL} Igor speaks English] or [C_{DECL} he speaks French]]]
b. [DECL [CLOSED [E [C_{DECL} Igor speaks English] or [C_{DECL} he speaks French]]]]

Given the assumptions that we made, *both* of these logical forms correspond to the following intonation pattern:

(93) Igor speaks ENGLISH↑ or he speaks FRENCH↓.

In this case, in the absence of E a final fall is induced by CLOSED, and contrastive accents have to be placed on both disjuncts because of the structural configuration—two full clausal disjuncts. Thus, inserting E is not predicted to have any major effect on prosody, except perhaps that the accentuation and pitch contours may be 'sharpened'.

We will assume that if a sentence with a certain intonation pattern admits two logical forms which only differ in the absence/presence of E, then its interpretation will be guided by the *strongest meaning hypothesis* (Dalrymple *et al.*, 1998; Winter, 2001). Since E is only licensed if it strengthens the semantic content of the construction that it is part of, this means that the sentence will be taken to have the logical form containing E. Thus, in the case of (93), the favored logical form will be (92b), which does not just signal that Igor speaks at least one of the two languages, but also that he does not speak both, i.e., that he speaks *exactly* one of them.

A parallel example can be given with two interrogative logical forms:

[10] Not sure whether this should necessarily be so.

(94) a. [INT [CLOSED [C_{INT} does Igor speak English] or [C_{DECL} does he speak French]]]
b. [INT [CLOSED [E [C_{INT} does Igor speak English] or [C_{DECL} does he speak French]]]]

These both correspond to the following intonation pattern:

(95) Does Igor speak ENGLISH↑ or does he speak FRENCH↓?

Again, we will assume that the interpretation of (95) will be guided by the strongest meaning hypothesis, which means that the favored logical form will be the one in (94b) (given a suitable notion of entailment for interrogatives, which we will discuss in Section 4).

In sum, our syntactic assumptions are that (i) lists consist of full declarative or interrogative clauses, separated by disjunction and 'governed' by two list classifiers, DECL/INT and OPEN/CLOSED, and (ii) the exclusive strengthening operator E may in principle be attached to any disjunctive phrase, affecting both its prosody and its interpretation. Before we can discuss the predictions that these assumptions give rise to in any detail, we have to say precisely how the logical forms that the syntax generates are interpreted. To this we turn next: we first lay out the semantic framework that we will use (Section 4) and then turn to the syntax-semantics interface and discuss the predictions that the account makes in detail (Section 5).

4 Semantic framework

Section 4.1 briefly reviews the most basic inquisitive semantics system, InqB (Ciardelli *et al.*, 2012), which includes a principled treatment of *disjunction* that will form the basis of our account of disjunctive lists. In Section 4.2, InqB is enriched with *presuppositions*, which is needed to deal with alternative questions. Section 4.3 introduces the so-called *projection operators* that inquisitive semantics gives rise to and which we will take to play a crucial role in the semantics of declarative and interrogative complementizers and list classifiers. Finally, Section 4.4 introduces the semantic operation of *exclusive strengthening* that we will associate with the E operator.

Once these semantic notions and operations are all in place, we will return to our declarative and interrogative lists in Section 5, and specify a compositional interpretation procedure. In presenting our account we purposely make a clear division between (i) the inquisitive semantics framework as such and the semantic operations that it makes available, and (ii) the way in which these semantic operations are matched up with the elements of the logical forms that we take to underlie declarative and interrogative lists. This is for three reasons.

First, we want to highlight the fact that, given the general notion of meaning in inquisitive semantics, the semantic operations that our account will rely on are all very natural and elementary operations on meanings. This fact is important if we want to answer the question *why* natural languages like English would have the means to express precisely these operations, rather than the infinitely many other potential operations that could in principle be performed on meanings as well.

Second, we want to highlight the fact that our proposal is *modular*. That is, even if our syntactic assumptions or our account of the syntax-semantics interface turn out to be problematic, the semantic operations that we will introduce may still turn out to play a crucial role, and perhaps with minor amendments of the syntax and/or syntax-semantics interface, the general thrust of the proposal may be preserved.

And finally—related to the previous two points—we want our theory of lists in English to be extendable to *other languages* in a relatively straightforward way. We hope that the modular nature of our proposal will make this possible. In particular, precisely because the semantic operations that our account relies on are such natural and elementary operations on meanings, we expect that many languages will have ways to express these operations, though what will certainly differ from language to language is *how* these operations are expressed (lexically, morphologically, prosodically).

4.1 Basic inquisitive semantics

The most basic inquisitive semantics system, InqB, can be thought of as the inquisitive counterpart of classical first-order logic. The basic logical language of InqB is exactly the same as that of classical first-order logic. Atomic sentences consist of an n-place predicate symbol $(P, Q, \ldots)$ together with n arguments, which are either individual constants $(a, b, \ldots)$ or variables $(x, y, \ldots)$. Complex sentences are built up from these elementary ones by means of the connectives $(\vee, \wedge, \neg, \rightarrow)$ and the quantifiers $(\exists, \forall)$. In much of what follows, the internal structure of atomic sentences will be irrelevant. Whenever this is the case we will use 0-place predicate symbols, written in lower case $(p, q \ldots)$, rather than explicit predicate-argument structures $(Pab, Qc, \ldots)$.

As will be reviewed below, in classical first-order logic the connectives and quantifiers are taken to express certain basic algebraic operations on meanings. For instance, $[\![p \vee q]\!]$ is the *join* of $[\![p]\!]$ and $[\![q]\!]$, and $[\![p \vee q]\!]$ is the *meet* of $[\![p]\!]$ and $[\![q]\!]$. In InqB, the connectives and quantifiers are taken to express precisely the same algebraic operations; only the notion of meaning itself is richer, embodying both informative and inquisitive content.

4.1.1 Propositions in inquisitive semantics

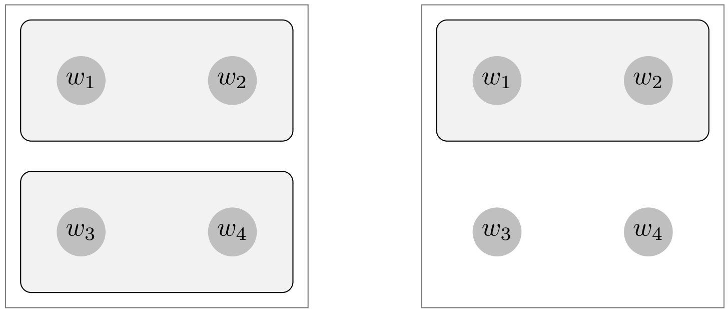
We start by recalling some standard notions. First of all, we assume a set of possible worlds, W, each of which encodes a possible way the world may be. Formally, every possible world $w \in W$ is a first-order model, i.e., a pair $\langle D, I \rangle$ where D is a domain of individuals, and I maps (i) every individual constant in the logical language to some individual in D, and (ii) every n-place predicate to a set of tuples consisting of n individuals in D. In particular, I maps every 0-place predicate to a set of tuples consisting of 0 individuals in D. There are only two such sets, namely the empty set, $\emptyset$, and the set containing the empty tuple, $\{\langle\rangle\}$. These are thought of as truth values, usually abbreviated as 0 and 1, respectively. If $w = \langle D, I \rangle$, P a predicate symbol and a an individual constant, then we will write $w(P)$ for $I(P)$ and $w(a)$ for $I(a)$. For simplicity, we will assume that every $w \in W$ has the same domain, and that every individual constant is mapped to the same individual in every world.

A set of possible worlds $s \subseteq W$ can be thought of as encoding a certain *body of information*, namely the information that the actual world corresponds to one of the elements of s. Similarly, a set of possible worlds $s \subseteq W$ can also be taken to encode the *information state* of one of the conversational participants, or the body of information that is shared among the conversational participants at a given point. As customary, we will refer to the latter body of information as the *common ground* of the conversation.

In classical logic, the semantic content of a sentence—the *proposition* that it expresses—is also construed as a set of possible worlds. Intuitively, a proposition carves out a region in the space of all possible worlds, and in asserting a sentence, a speaker is taken to provide the information that the actual world is located within this region. In this way, the proposition expressed by the sentence captures the *informative content* of the sentence.

Now, if we want to capture the meaning of declarative and interrogative lists, it is not enough to just capture their informative content. Rather, we want a notion of propositions that is flexible enough to capture both their informative and their inquisitive content. This means that propositions cannot simply be construed as sets of possible worlds. However, there is a very natural generalization of the classical notion of propositions that does suit our purpose. Namely, propositions can be construed as *sets of information states*. In uttering a sentence, a speaker can then be taken to steer the common ground of the conversation towards one of the states in the proposition expressed, while at the same time providing the information that the actual world must be contained in one of these states. Thus, on this view we can think of a proposition as embodying a proposal to enhance the common ground in one or more ways, excluding possible worlds that would not survive any of the proposed enhancements as candidates for the actual world.

An information state s is contained in a proposition A just in case establishing s as the new common ground is a way of *settling* the proposal embodied by A. For short, we say that A is settled



(a) Does Igor speaks English? (b) Igor speaks English

Figure 1: Some simple inquisitive semantics propositions.

in s in this case. Further, we assume that if A is settled in a certain state s then it is also settled in any more informed state $s' \subset s$. This means that propositions are *downward closed*: if $s \in A$ and $s' \subset s$, then $s' \in A$ as well. Finally, we will assume that the *inconsistent* state, $\emptyset$, trivially settles any proposition. This means that any proposition has $\emptyset$ as an element and is therefore itself non-empty. These considerations lead to the following characterization of propositions:

Definition 1 (Propositions in inquisitive semantics)**.**
A proposition in inquisitive semantics is a non-empty, downward closed set of information states.

Among the states in which a proposition A is settled, the ones that are easiest to reach are those that contain least information. The states in A that contain least information are those that contain most possible worlds, i.e., they are the *maximal elements* of A w.r.t. inclusion. These maximal elements are refered to in inquisitive semantics as the *alternatives* in A. In depicting a proposition, we will generally only depict the alternatives that it contains.

Finally, since in uttering a sentence that expresses a proposition A a speaker is taken to provide the information that the actual world is contained in one of the elements of A, i.e., in $\bigcup A$, we refer to $\bigcup A$ as the *informative content* of A, and denote it as $\mathsf{info}(A)$.

To illustrate these notions, consider the following two sentences:

(96) Does Igor speak English↑?

(97) Igor speaks English↓.

These sentences may be taken to express the propositions depicted in Figure 1, where w_1 and w_2 are worlds where Igor speaks English, w_3 and w_4 are worlds where Igor doesn't speak English, and the shaded rectangles are the alternatives contained in the given propositions (by downward closure, all substates of these alternatives are also contained in the given propositions).

The proposition in Figure 1(a) captures the fact that in uttering the polar interrogative in (96), a speaker (i) provides the trivial information that the actual world must be w_1, w_2, w_3, or w_4 (all options are open) and (ii) steers the common ground towards a state that is either within $\{w_1, w_2\}$, where it is known that Igor speaks English, or within $\{w_3, w_4\}$, where it is known that Igor doesn't speak English. Other conversational participants are requested to provide information in order to establish such a common ground.

On the other hand, the proposition in Figure 1(b) captures the fact that in uttering the declarative in (97), a speaker (i) provides the information that the actual world must be either w_1 or w_2, i.e., one where Igor speaks English, and (ii) steers the common ground of the conversation towards a state in which it is commonly accepted that Igor speaks English. In order to reach such a common ground, it is sufficient for other participants to accept the information that the speaker herself already provided in uttering the sentence; no further information is needed.

4.1.2 Informative and inquisitive propositions

Notice that in the case of the polar interrogative in (96), the information that is provided is *trivial* in the sense that it does not exclude any candidate for the actual world. A proposition A is called *informative* just in case it does exclude at least one candidate for the actual world, i.e., iff $\mathsf{info}(A) \neq W$.

On the other hand, in the case of the declarative in (97), the inquisitive component of the proposition expressed is trivial, in the sense that in order to reach a state where the proposition is settled, other conversational participants only need to accept the informative content of the proposition expressed, and no further information is required. A proposition A is called *inquisitive* just in case settling A requires more than just accepting $\mathsf{info}(A)$, i.e., iff $\mathsf{info}(A) \notin A$.

Given a picture of a proposition it is easy to see whether it is inquisitive or not. This is because, under the assumption that there are only finitely many possible worlds—and this is a safe assumption to make for all the examples to be considered in this paper—a proposition is inquisitive just in case it contains at least two alternatives. For instance, the proposition in Figure 1(a) contains two alternatives, which means that it is inquisitive, while the proposition in Figure 1(b) contains only one alternative, which means that it is not inquisitive.

4.1.3 Entailment and algebraic operations

In order for one proposition A to entail another proposition B in inquisitive semantics, two natural conditions need to be fulfilled: (i) A has to be at least as informative as B, and (ii) A has to be at least as inquisitive as B. Whether the first condition is satisfied can be checked by comparing $\mathsf{info}(A)$ to $\mathsf{info}(B)$. Just as in classical logic, A is at least as informative as B iff $\mathsf{info}(A) \subseteq \mathsf{info}(B)$. But what does it mean for A to be at least as *inquisitive* as B? This can be made precise by comparing what it takes to settle A with what it takes to settle B. More specifically, A is at least as inquisitive as B just in case every state that settles A also settles B. But this just means that $A \subseteq B$. And moreover, if $A \subseteq B$, then it automatically holds that $\mathsf{info}(A) \subseteq \mathsf{info}(B)$ as well. Thus, at a formal level entailment in inquisitive semantics just amounts to inclusion, exactly as in classical logic.

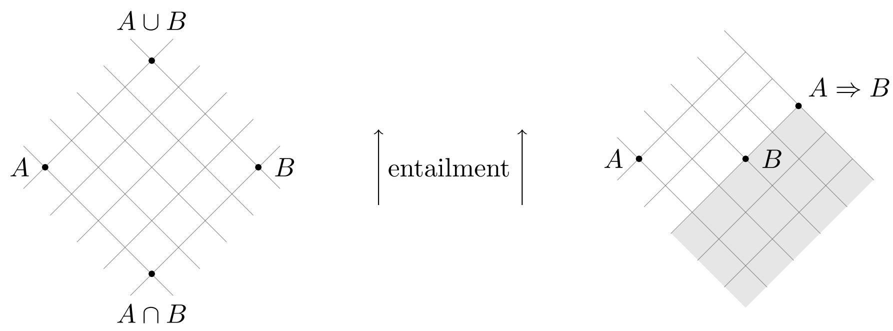
Definition 2 (Entailment in inquisitive semantics)**.** $A \models B$ iff $A \subseteq B$

Now, entailment induces a *partial order* on the set of all propositions, and any partially ordering set has a certain algebraic structure, which comes with certain basic algebraic operations. Both in classical logic and in InqB the set of all propositions ordered by entailment forms a so-called *Heyting algebra*, which comes with four basic operations: *join*, *meet*, *relative pseudo-complementation* and *absolute pseudo-complementation*. The connectives $\vee$, $\wedge$, $\neg$, and $\to$ are taken to express precisely these operations. Let us therefore briefly recall how the operations are defined.

The *join* of two propositions A and B is the *least upper bound* of A and B with respect to entailment, i.e., the strongest proposition that is entailed by both A and B, as depicted in Figure 2(a). Both in classical logic and in InqB this least upper bound amounts precisely to the *union* of the two propositions: $A \cup B$ (though recall that in classical logic both A and B are sets of worlds, while in InqB both A and B are sets of information states).

The *meet* of A and B on the other hand, is the *greatest lower bound* of A and B with respect to entailment, i.e., the weakest proposition that entails both A and B, as depicted again in Figure 2(a). Both in classical logic and in InqB this greatest lower bound amounts precisely to the *intersection* of the two propositions: $A \cap B$.

The *pseudo-complement* of a proposition A *relative to* another proposition B, which is denoted as $A \Rightarrow B$, can be thought of intuitively as the 'difference' between A and B: it is the weakest proposition C such that A and C together contain at least as much information as B. More formally, it is the weakest proposition C such that $A \cap C \models B$. This is visualized in Figure 2(b). The shaded area in the figure is the set of all propositions C which are such that $A \cap C \models B$. The weakest



(a) join and meet

(b) relative pseudo-complement

Figure 2: Join, meet, and relative pseudo-complement.

among these, i.e., the topmost one, is the pseudo-complement of A relative to B. In classical logic, this proposition consists of all possible worlds which, if contained in A, are also contained in B:

$$\textit{Classical logic}: \quad A \Rightarrow B \ = \ \{w \mid \text{if } w \in A \text{ then } w \in B \text{ as well}\}$$

In InqB on the other hand, $A \Rightarrow B$ is not a set of worlds but a set of information states, namely those information states s such that any $s' \subseteq s$ which is in A is also in B:

$$\mathsf{InqB}: \quad A \Rightarrow B \ = \ \{s \mid \forall s' \subseteq s: \text{ if } s' \in A \text{ then } s' \in B \text{ as well}\}$$

Absolute pseudo-complementation is a limit case of relative pseudo-complementation. The *absolute pseudo-complement* of a proposition A, which will be denoted as A^*, is the weakest proposition C such that $A \cap C$ entails *any* other proposition. Since the only proposition that entails any other proposition is the *empty* proposition, denoted as $\bot$, A^* can be characterized as the weakest proposition C such that $A \cap C = \bot$. In classical logic, it consists simply of all worlds that are not in A itself:[11]

$$\textit{Classical logic}: \quad A^* = \{w \mid w \notin A\}$$

In InqB on the other hand, A^* is again not a set of worlds but a set of information states, namely those information states s such that no non-empty $s' \subseteq s$ is in A:

$$\mathsf{InqB}: \quad A^* \ = \ \{s \mid \forall s' \subseteq s: \text{ if } s' \neq \emptyset \text{ then } s' \notin A\}$$

As anticipated above, both in classical logic and in InqB each connective is associated with one of these basic algebraic operations: disjunction expresses *join*, conjunction expresses *meet*, implication expresses *relative pseudo-complementation*, and negation expresses *absolute pseudo-complementation*.[12] Using φ and ψ to range over arbitrary sentences in the logical language, and $[\varphi]$ for the proposition expressed by φ, this can be formulated concisely as follows:

[11] In classical logic it does not only hold for any proposition A that $A \cap A^*$ is the *strongest* of all propositions, i.e., the proposition that entails all other propositions (this is directly enforced by the definition of A^*), but also that $A \cup A^*$ amounts to the *weakest* of all propositions, i.e., the proposition that is entailed by all other propositions. Because it has this special property, A^* is called the *Boolean complement* of A in classical logic, and the set of all classical propositions ordered by entailment forms a *Boolean algebra*, a special kind of Heyting algebra. In InqB, this special property is lost as a direct consequence of the fact that meaning is no longer identified with informative content but also encompasses inquisitive content. Namely, in order to be entailed by all other propositions in InqB, $A \cup A^*$ has to be neither informative nor inquisitive. However, while $A \cup A^*$ is never informative, as in classical logic, it *is* typically inquisitive.

[12] In classical *first-order* logic, and in first-order InqB, the existential and the universal quantifier are also treated as *join* and *meet* operators, respectively, applied to a possibly infinite set of propositions.

$$\begin{array}{llll}
[\varphi \vee \psi] & := & [\varphi] \cup [\psi] & \textit{join} \\
[\varphi \wedge \psi] & := & [\varphi] \cap [\psi] & \textit{meet} \\
[\varphi \rightarrow \psi] & := & [\varphi] \Rightarrow [\psi] & \textit{relative pseudo-complementation} \\
[\neg\varphi] & := & [\varphi]^* & \textit{absolute pseudo-complementation}
\end{array}$$

It is natural to expect that natural languages will generally have ways to express these basic algebraic operations as well, just like it is natural to expect that languages generally have ways to express basic operations on quantities, like addition and substraction. And indeed, in language after language words or morphemes have been found that may be taken, at least at first sight, to fulfill exactly this purpose (e.g., Haspelmath, 2007; Gil, 2013; Szabolcsi, 2015). The algebraic perspective on meaning provides a simple explanation for the cross-linguistic ubiquity of such words.

The system InqB consists of the above four clauses, plus two clauses for the quantifiers and one for atomic sentences. These clauses are defined relative to an assignment function g, which maps any variable x in the logical language to an individual in the domain D that is shared by all possible worlds. If t is either an individual constant or a variable, w a possible world and g and assignment function, we write $[t]_{w,g}$ to denote either $w(t)$ or $g(t)$, whichever is well-defined (which depends on whether t is an individual constant or a variable). The clause for atomic sentences can then be formulated concisely as follows:

$$[Pt_1 \dots t_n]_g \quad := \quad \{s \mid \forall w \in s : \langle [t_1]_{w,g}, \dots, [t_n]_{w,g} \rangle \in w(P)\}$$

In words, this clause simply says that the proposition expressed by an atomic sentence $Pt_1 \dots t_n$ is the set of all information states consisting exclusively of worlds where the sentence is true, i.e., where the individuals denoted by $t_1, \dots, t_n$ stand in the relation expressed by P. For atomic sentences that consist of a 0-place predicate p without any arguments this amounts to:

$$[p] \quad := \quad \{s \mid \forall w \in s : w(p) = 1\}$$

In words, the proposition expressed by an atomic sentence p is the set of all information states consisting exclusively of worlds where p is true.

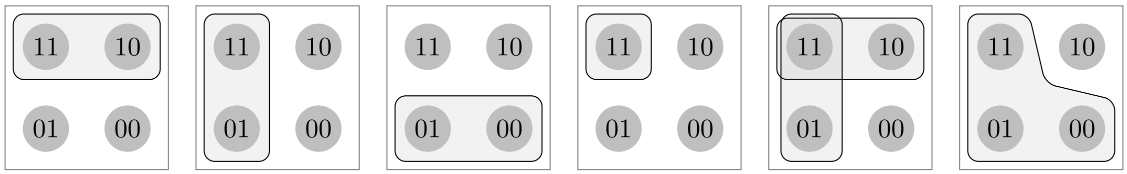
Finally, let us turn to the quantifiers. If g is an assignment function, x a variable, and d an individual, we will write $g[x/d]$ for the assignment function that maps x to d and is otherwise exactly like g. The clauses for the quantifiers can then be formulated as follows.

$$\begin{array}{lll}
[\exists x.\varphi]_g & := & \bigcup_{d \in D} \; [\varphi]_{g[x/d]} \\
[\forall x.\varphi]_g & := & \bigcap_{d \in D} \; [\varphi]_{g[x/d]}
\end{array}$$

Note that the quantifiers are again treated exactly as in classical first-order logic: the proposition expressed by $\exists x.\varphi$ relative to an assignment function g is the *join* of all the propositions that φ expresses relative to some $g[x/d]$, where d can be any individual in the domain, and the proposition expressed by $\forall x.\varphi$ relative to g is the *meet* of all these propositions.

This completes our brief review of InqB. Now, let us look at a number of examples to see how the system behaves.[13] We will assume a very simple language, with just two 0-place predicate symbols, p and q. The propositions expressed by some sentences in this language are depicted in Figure 3. In each diagram, there are four possible worlds: 11 is a world where both p and q are true, 10 a world where p is true but q is false, 01 a world where p is false and q is true, and 00 a world where both p and q are false. Notice that most of the depicted propositions contain only one alternative, which means that they are not inquisitive. Moreover, notice that in each of these cases the unique alternative corresponds exactly to the proposition that the sentence in question expresses in classical

[13]For a comprehensive overview of InqB with many more illustrative examples, see Ciardelli *et al.* (2012); for more on the algebraic underpinning of the system, see Roelofsen (2013); and for an in-depth investigation of its logical properties, see Ciardelli (2009); Ciardelli and Roelofsen (2011).



(a) $[p]$ (b) $[q]$ (c) $[\neg p]$ (d) $[p \wedge q]$ (e) $[p \vee q]$ (f) $[p \to q]$

Figure 3: Propositions expressed by some simple sentences in InqB.

logic. More generally, it holds in InqB that for any sentence φ, $\mathsf{info}([\varphi])$ always coincides precisely with the proposition expressed by φ in classical logic.

Now consider the proposition expressed by $p \vee q$, depicted in Figure 3(e). This is the only proposition among the ones that are depicted here that is inquisitive: it contains two alternatives, one corresponding to each disjunct. Thus, while disjunction is treated as a *join* operator, as in classical logic, it generates multiple alternatives and is therefore a source of inquisitiveness.[14]

This treatment of disjunction will be at the heart of our account of declarative and interrogative lists. However, the InqB system does not yet provide all the necessary ingredients to start formulating such an account. In particular, in order to capture the meaning of alternative questions, presuppositions have to be brought into the picture. To this we turn next.

4.2 Presuppositional inquisitive semantics

4.2.1 Presuppositional meanings

The formal notion of meaning in InqB is intended to capture informative and inquisitive content. These are two important aspects of meaning, but of course there are further aspects as well. In order to be able to capture these, the basic notion of meaning that is adopted in InqB needs to be further extended. Ciardelli *et al.* (2012) present a presuppositional extension of the system, which we will adopt here with one amendment (see footnote 16 below). A closely related presuppositional inquisitive semantics is employed in AnderBois (2012).

We will say that a *presuppositional meaning* is a pair $\langle \pi, A \rangle$, where π is an information state, i.e., a set of worlds, and A is a proposition *over* π, i.e., a non-empty, downward closed set of information states that are all contained in π.[15] If the presuppositional meaning of a sentence is $\langle \pi, A \rangle$, then we refer to π as the presupposition of the sentence, and to A as the proposition that the sentence expresses. In uttering a sentence with meaning $\langle \pi, A \rangle$, a speaker is taken (i) to presuppose that the common ground of the conversation is contained in π, (ii) to steer the common ground towards one of the states in A, and (iii) to provide the information that the actual world must be contained in $\bigcup A$. Notice that (ii) and (iii) are exactly as before; only (i), which concerns the presupposition π, has been added. The condition that A should be a proposition *over* π ensures that a speaker can never steer the common ground towards a state that is incompatible with what she presupposes.

[14] Disjunction has also been treated as generating multiple alternatives in the framework of *alternative semantics* (see, e.g., Simons, 2005a; Alonso-Ovalle, 2006; Aloni, 2007). Several forceful empirical arguments for this treatment have been given in this line of work, concerning the behavior of disjunction under modals, and in conditionals and imperatives. However, in alternative semantics, the treatment of disjunction as generating multiple alternatives is incompatible with the classical treatment of disjunction as a *join* operator w.r.t. entailment, which means that the algebraic explanation of the cross-linguistic ubiquity of disjunction words is lost. The treatment of disjunction in InqB can be seen as a reconciliation of the two approaches (see Roelofsen, 2015).

[15] In Ciardelli *et al.* (2012) it is shown how this static notion of presuppositional meanings can be related to a *dynamic* notion of presuppositional meanings as partial functions over discourse contexts (see Heim, 1983, and much subsequent work). Under certain assumptions which are innocuous in the context of the present paper, there is a one-to-one mapping between static and dynamic presuppositional meanings. Ultimately the dynamic notion is more general, but for simplicity we stick to static meanings here.

Definition 3 (Presuppositional meanings)**.**
A presuppositional meaning is a pair $\langle \pi, A\rangle$, where π is an information state and A is a proposition over π, i.e., a proposition whose elements are all contained in π.

4.2.2 Presupposition projection and relativized algebraic operations on propositions

We now define a presuppositional inquisitive semantics for a first-order language. To specify such a semantics, the basic InqB system has to be combined with an account of presupposition projection. Many accounts of presupposition projection exist, and we will not take a stance here on which of these accounts is empirically or explanatorily most satisfactory (see Beaver and Geurts, 2013, for a recent overview). Rather, following Ciardelli *et al.* (2012), we will show how one particularly influential account of presupposition projection, namely that of Karttunen (1974), can be integrated into InqB. This will be sufficient for our present purposes, and a more comprehensive investigation of various presupposition projection mechanisms in the inquisitive setting would lead us too far afield.

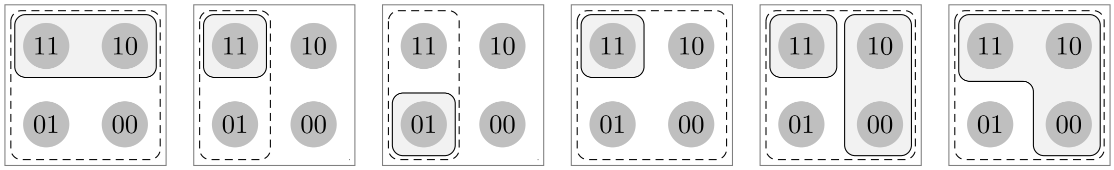
We will consider the same first-order language that we considered before, only now we will include, besides plain atomic sentences, *presuppositional* atomic sentences as well. These are of the form p_q, where p and q are plain atomic sentences. The proposition expressed by a sentence φ relative to an assignment g will be denoted as $[\varphi]_g$, as before, and its informative content as $\mathsf{info}_g(\varphi) := \bigcup[\varphi]_g$. The presupposition of φ will be denoted as $\mathsf{presup}_g(\varphi)$, and its presuppositional meaning either as $\langle\mathsf{presup}_g(\varphi), [\varphi]_g\rangle$, or more concisely as $[\![\varphi]\!]_g$. Reference to g will often be omitted.

We formulate Karttunen's account of presupposition projection by recursively defining a *presupposition satisfaction* relation $\Vdash$ between information states and sentences (the clauses for the connectives are taken directly from Karttunen (1974), the ones for atomic sentences and the quantifiers have been added).

Definition 4 (Presupposition satisfaction)**.**

$s \Vdash_g p$	always	
$s \Vdash_g p_q$	iff	$s \in [q]_g$
$s \Vdash_g \neg\varphi$	iff	$s \Vdash_g \varphi$
$s \Vdash_g \varphi \wedge \psi$	iff	$s \Vdash_g \varphi$ and $s \cap \mathsf{info}_g(\varphi) \Vdash_g \psi$
$s \Vdash_g \varphi \vee \psi$	iff	$s \Vdash_g \varphi$ and $s \setminus \mathsf{info}_g(\varphi) \Vdash_g \psi$
$s \Vdash_g \varphi \to \psi$	iff	$s \Vdash_g \varphi$ and $s \cap \mathsf{info}_g(\varphi) \Vdash_g \psi$
$s \Vdash_g \forall x.\varphi$	iff	$s \Vdash_{g[x/d]} \varphi$ for all $d \in D$
$s \Vdash_g \exists x.\varphi$	iff	$s \Vdash_{g[x/d]} \varphi$ for some $d \in D$

These clauses are to be read as follows. A plain atomic sentence p is non-presuppositional and therefore its presupposition is trivially satisfied in any information state. The presupposition of a presuppositional atomic sentence p_q is satisfied in a state s just in case the information available in s ensures that q holds. The presupposition of a negated sentence $\neg\varphi$ is satisfied just in case the presupposition of φ is. The presupposition of a conjunction $\varphi \wedge \psi$ is satisfied in a state s just in case the presupposition of φ is satisfied in s, and the presupposition of ψ is satisfied in the state $s \cap \mathsf{info}(\varphi)$; thus, when evaluating whether the presupposition of the second conjunct is satisfied, the information provided by the first conjunct may be assumed in addition to the information already available in s. The presupposition of a disjunction $\varphi \vee \psi$ is satisfied in a state s just in case the presupposition of φ is satisfied in s, and the presupposition of ψ is satisfied in the state $s \setminus \mathsf{info}(\varphi)$; so, when evaluating the second disjunct, the information that the first disjunct does *not* hold may be assumed in addition to the information available in s. The presupposition of an implication $\varphi \to \psi$ is satisfied in s just in case the presupposition of φ is satisfied in s and the presupposition of ψ is satisfied in the state $s \cap \mathsf{info}(\varphi)$; so, when evaluating the consequent of an implication, the information provided by the antecedent may be assumed. Finally, the presupposition of $\forall x.\varphi$ is



(a) p (b) p_q (c) $\neg p_q$ (d) $q \wedge p_q$ (e) $\neg q \vee p_q$ (f) $q \rightarrow p_q$

Figure 4: Presuppositional meanings expressed by some simple sentences.

satisfied in s relative to g just in case the presupposition of φ is satisfied in s relative to $g[x/d]$ for every individual $d \in D$, and the presupposition of $\exists x.\varphi$ is satisfied in s relative to g just in case the presupposition of φ is satisfied in s relative to $g[x/d]$ for some individual $d \in D$.

Given this recursive definition of the satisfaction relation, the presupposition of a sentence φ, $\mathsf{presup}_g(\varphi)$, can be defined as the set of worlds that are included in some state s such that $s \Vdash_g \varphi$.

Definition 5 (The presupposition of a sentence)**.** $\mathsf{presup}_g(\varphi) := \bigcup\{s \mid s \Vdash_g \varphi\}$

The proposition expressed by a complex sentence will be defined in terms of the algebraic operations familiar from InqB. However, the outcome of these operations will now always be *restricted* to the presupposition of the sentence in question. For instance, the proposition expressed by $\varphi \wedge \psi$ will be the meet of $[\varphi]$ and $[\psi]$, restricted to $\mathsf{presup}(\varphi \wedge \psi)$. This will ensure that for any φ, $[\varphi]$ is a proposition *over* $\mathsf{presup}(\varphi)$, as required by our notion of presuppositional meanings.

Definition 6 (Restricting a proposition to a set of worlds)**.**
If A is a proposition and s a set of worlds, then the restriction of A to s, denoted $A \restriction s$, is the proposition $\{t \in A \mid t \subseteq s\}$.

Definition 7 (The proposition expressed by a sentence)**.**

$$
\begin{array}{lcl}
[p]_g & := & \wp\{w \mid w(p) = 1\} \\
[p_q]_g & := & \wp\{w \mid w(p) = 1 \text{ and } w(q) = 1\} \\
[\neg\varphi]_g & := & [\varphi]_g^* \restriction \mathsf{presup}_g(\neg\varphi) \\
[\varphi \wedge \psi]_g & := & ([\varphi]_g \cap [\psi]_g) \restriction \mathsf{presup}_g(\varphi \wedge \psi) \\
[\varphi \vee \psi]_g & := & ([\varphi]_g \cup [\psi]_g) \restriction \mathsf{presup}_g(\varphi \vee \psi) \\
[\varphi \rightarrow \psi]_g & := & ([\varphi]_g \Rightarrow [\psi]_g) \restriction \mathsf{presup}_g(\varphi \rightarrow \psi) \\
[\forall\varphi]_g & := & [\forall x.\varphi]_g \restriction \mathsf{presup}_g(\forall x.\varphi) \\
[\exists\varphi]_g & := & [\exists x.\varphi]_g \restriction \mathsf{presup}_g(\exists x.\varphi)
\end{array}
$$

We will refer to the system defined here as InqP. Notice that Definitions 4, 5, and 7 together provide a *simultaneous* recursive characterization of $\mathsf{presup}(\varphi)$ and $[\varphi]$ for any φ. For instance, in order to determine $[p \rightarrow q]$ we first have to determine $\mathsf{presup}(p \rightarrow q)$, which in turn requires us to determine $\mathsf{info}(p)$, which is defined in terms of $[p]$. So, neither the proposition expressed by a sentence nor its presupposition can generally be determined in isolation, the two are tightly interwoven.[16]

Figure 4 depicts the presuppositional meanings expressed by some simple sentences in InqP. In each case, the presupposition $\mathsf{presup}(\varphi)$ is depicted with dashed borders, and of the proposition

[16] This is not the case in the system defined in Ciardelli *et al.* (2012). There, the propositions expressed by sentences are defined independently of their presuppositions. This way, however, it cannot be guaranteed that the proposition expressed by a sentence is always a proposition *over* its presupposition, as required by our notion of presuppositional meanings. This is what required the amendment alluded to earlier.

$[\varphi]$, only the maximal elements are depicted, as before, with solid borders. Figure 9(a) depicts the meaning of a plain atomic sentence p. Notice that the presupposition of p covers the entire logical space, which means that in uttering this sentence, a speaker effectively does not presuppose anything. We say that the presupposition is *trivial* in this case.

Figure 4(b) depicts the meaning of a presuppositional atomic sentence, p_q. In this case, the presupposition of the sentence is the set of all worlds where q is true, and the proposition expressed by the sentence is the set of all states that consist exclusively of worlds where both p and q are true; in this case there is only one such a world, namely 11.

Figure 4(c) depicts the meaning of $\neg p_q$. This sentence has the same presupposition as p_q itself. More generally, for any φ, the presupposition of $\neg\varphi$ is the same as that of φ in InqP. Turning back to the specific case of $\neg p_q$, the proposition expressed by this sentence is the set of all states that consist exclusively of worlds where q is true and p is false; there is only one such a world, namely 01.

Figure 4(d) depicts the meaning of $q \wedge p_q$. A state s satisfies the presuppositions of this sentence just in case (i) it satisfies the presuppositions of q, which is always the case, and (ii) $s \cap \mathsf{info}(q)$ satisfies the presuppositions of p_q. The latter is also always the case. Thus, the presupposition of $q \wedge p_q$ is trivial; it covers the entire logical space. On the other hand, the proposition expressed by $q \wedge p_q$ is the same as that expressed by $q \wedge p$, i.e., the set of states that consist exclusively of worlds where both q and p are true.

Figure 4(e) depicts the meaning of $\neg q \vee p_q$. A state s satisfies the presuppositions of this sentence just in case (i) it satisfies the presuppositions of $\neg q$, which is always the case, and (ii) $s \setminus \mathsf{info}(\neg q)$ satisfies the presuppositions of p_q. The latter is also always the case. Thus, the presupposition of $\neg q \vee p_q$ is again trivial. The proposition expressed by this sentence, on the other hand, is obtained by taking the join of $[\neg q]$ and $[p_q]$. This results in a proposition containing two alternatives, one consisting of all worlds where both p and q are true, and one consisting of all worlds where q is false.

Figure 4(f) depicts the meaning of $q \rightarrow p_q$. A state s satisfies the presuppositions of this sentence just in case (i) it satisfies the presuppositions of q, which is always the case, and (ii) $s \cap \mathsf{info}(q)$ satisfies the presuppositions of p_q. The latter is again always the case. Thus, the presupposition of $q \rightarrow p_q$ is trivial as well. The proposition expressed by this sentence, on the other hand, is obtained by taking the pseudo-complement of $[q]$ relative to $[p_q]$. This results in a proposition containing just one alternative, consisting of all worlds where either q is false or p is true.

4.2.3 Informative and inquisitive sentences in InqP

Following Ciardelli *et al.* (2012) we will say that a sentence φ is *informative* in InqP just in case $\mathsf{info}(\varphi) \neq \mathsf{presup}(\varphi)$, which means that in uttering φ, a speaker provides strictly more information than what she presupposes. Notice that if the presupposition of φ is trivial, i.e., if $\mathsf{presup}(\varphi) = W$, then φ is informative just in case $\mathsf{info}(\varphi) \neq W$, which is precisely the characterization of informative sentences that we had in InqB.

On the other hand, we will say that φ is *inquisitive* in InqP just in case $\mathsf{info}(\varphi) \notin [\varphi]$, which is precisely what we had in InqB as well. This extends directly to InqP because whether a sentence is inquisitive or not does not depend in any way on its presupposition.

Definition 8 (Informative and inquisitive sentences)**.**

- φ is informative in InqP iff $\mathsf{info}(\varphi) \neq \mathsf{presup}(\varphi)$
- φ is inquisitive in InqP iff $\mathsf{info}(\varphi) \notin [\varphi]$

If φ is not informative, we will say that the informative content of φ is *trivial*. Similarly, if φ is not inquisitive, we will say that its inquisitive content is trivial. In the next subsection we will consider operators that trivialize either the informative or the inquisitive content of a sentence. Such operators will play a crucial role in our account of list classifiers and complementizers.

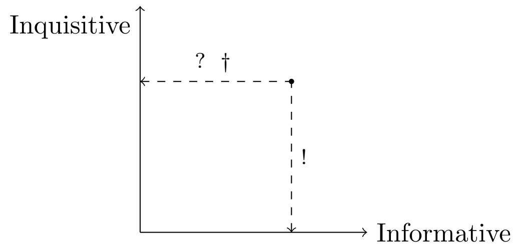


Figure 5: Projection operators.

4.3 Informative and inquisitive projection operators

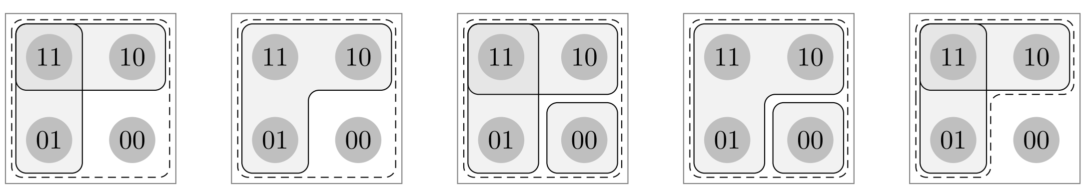
As depicted in Figure 5, sentences can be thought of in inquisitive semantics as inhabiting a two-dimensional space. On the horizontal axis, there are sentences that are purely informative, i.e., whose inquisitive content is trivial. On the vertical axis, there are sentences that are purely inquisitive, i.e., whose informative content is trivial. All other sentences, which are both informative and inquisitive, are located somewhere in the plain, off the axes.

Given this picture, it is natural to consider operations that *project* sentences onto one of the axes, trivializing either their informative or their inquisitive content. We will consider three such projection operators: one that trivializes inquisitive content, !, and two that trivialize informative content, ? and †.[17] These are defined as follows.

Definition 9 (Projection operators)**.**

- $[\![!\varphi]\!] := \langle \mathsf{presup}(\varphi), \wp(\mathsf{info}(\varphi)) \rangle$
- $[\![?\varphi]\!] := \langle \mathsf{presup}(\varphi), [\varphi] \cup \wp(\mathsf{presup}(\varphi) \setminus \mathsf{info}(\varphi)) \rangle$
- $[\![\dagger\varphi]\!] := \langle \mathsf{info}(\varphi), [\varphi] \rangle$

The effect of the operators is illustrated in Figure 6. Figure 6(a) depicts the meaning of a simple disjunction in our logical language, $p \vee q$, which is both informative and inquisitive. Figures 6(b)-6(d) depict the result of applying ? and ! to this disjunction, either separately or one after the other, and finally, Figure 6(e) depicts the result of applying †.



(a) $p \vee q$ (b) $!(p \vee q)$ (c) $?(p \vee q)$ (d) $?!(p \vee q)$ (e) $\dagger(p \vee q)$

Figure 6: Various projection operators applied to a simple disjunction.

Let us consider each case in more detail. First, as illustrated in Figure 6(b), ! is defined in such a way that it 'flattens' the alternatives in $[\varphi]$. That is, $[!\varphi]$ always contains a single alternative,

[17] Projection operators have been discussed previously in various places in the literature on inquisitive semantics (see, e.g., Mascarenhas, 2009; Groenendijk and Roelofsen, 2009; Ciardelli, 2009; Roelofsen, 2013). Most of these discussions are restricted, however, to ! and ?. The reason that † is left out of the picture is that, as we will see, it affects the *presuppositions* of a sentence rather than its at-issue content. Since in InqB presuppositions are left out of consideration, the † operator does not have a role to play there either. The only place where the † operator has been discussed before is Ciardelli *et al.* (2012).

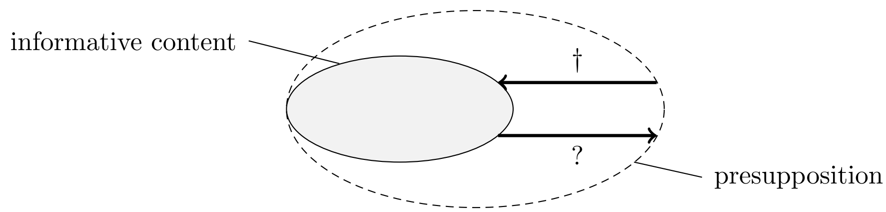


Figure 7: Two strategies to trivialize informative content.

which is $\mathsf{info}(\varphi)$, i.e., the union of all the elements of $[\varphi]$. As a consequence, $!\varphi$ is never inquisitive, while it always has exactly the same presupposition and the same informative content as φ. Since ! trivializes the inquisitive content of φ, while keeping other aspects of the meaning of φ constant, it can indeed be seen as a projection operator that projects φ onto the horizontal axis.[18]

Next, as illustrated in Figure 9(f), $?\varphi$ is defined in such a way that, whenever φ is informative, i.e., whenever $(\mathsf{presup}(\varphi) \setminus \mathsf{info}(\varphi)) \neq \emptyset$, it adds $(\mathsf{presup}(\varphi) \setminus \mathsf{info}(\varphi))$ as an alternative to $[\varphi]$. As a consequence, (i) $?\varphi$ is never informative, (ii) it always has exactly the same presupposition as φ, and (iii) it always has exactly the same *decision set* as φ, which is defined as the set of states that either establish that the actual world is contained in some element of $[\varphi]$, or that the actual world is *not* contained in *any* element of $[\varphi]$ (cf. Roelofsen, 2013, section 3.8). Since ? trivializes the informative content of φ, while keeping other aspects of the meaning of φ constant, it can be seen as a projection operator that projects φ onto the vertical axis.

It can be shown that for any φ, $!\varphi$ is equivalent with $\neg\neg\varphi$, and $?\varphi$ is equivalent with $\varphi \vee \neg\varphi$. This means that the semantic operations that these two projection operators express are simple combinations of the algebraic operations that we saw above: $[!\varphi]$ can be obtained by double pseudo-complementation, and $[?\varphi]$ by taking the join of $[\varphi]$ and its pseudo-complement $[\varphi]^*$.[19]

Fact 1 (Algebraic characterization of ! and ?)**.** For any φ:

- $[!\varphi] = ([\varphi]^*)^*$
- $[?\varphi] = [\varphi] \cup [\varphi]^*$

Figure 6(d) illustrates what happens if we apply ? after !. First, ! flattens the alternatives in $[\varphi]$, getting rid of inquisitiveness, but then ? adds a second alternative, reinstating inquisitiveness, though now the alternatives are different from the ones we started out with.

Finally, as illustrated in Figure 6(e), † strengthens the presupposition of φ in such a way that it comes to coincide with $\mathsf{info}(\varphi)$. As a consequence, $\dagger\varphi$ is never informative, while it always expresses exactly the same proposition as φ.

Notice that the main effect of both † and ? is to trivialize the informative content of a sentence, i.e., to project it onto the vertical axis of the space depicted in Figure 5. In order to do this, they must ensure that the informative content of the sentence comes to coincide with its presupposition. As visualized in Figure 7, the two operators achieve this in two different ways: † strengthens the presupposition, while ? weakens the informative content. In both cases, other basic aspects of the meaning of the sentence are kept constant as much as possible.

The fact that !, ?, and † function as projection operators leads us to expect that, just like the algebraic operations discussed earlier, they may very well be expressible in many natural languages.

[18] The ! operator is closely related to the *existential closure* operator of Kratzer and Shimoyama (2002). Indeed, both yield a proposition containing a single alternative, $\bigcup[\varphi]$. The difference is that the proposition delivered by ! is downward closed, which means that it does not only contain $\bigcup[\varphi]$ but also all substates thereof. The existential closure operator on the other hand delivers a proposition that contains just $\bigcup[\varphi]$.

[19] This result is well-known for InqB. However, its extension to InqP is new. In particular, in the more liberal version of InqP that was specified in Ciardelli *et al.* (2012), this result does not hold, for reasons alluded to in footnote 16.

Indeed, as already alluded to above, they will play a central role in our analysis of declarative and interrogative lists. It is worth emphasizing, however, that the operators have not been invented *ad hoc* to account for any particular linguistic phenomena. Rather, they arise directly from purely conceptual considerations concerning the kind of meanings that are assigned to sentences in InqP. Thus, to the extent that there are indeed constructions in natural languages that express these operators, the approach we have taken here does not just make it possible to provide an adequate *description* of the semantic contribution of such constructions, but also an *explanation* of why such constructions would exist at all in natural languages.

We are almost ready now to turn to the analysis of declarative and interrogative lists. We just need one more semantic operation.

4.4 Exclusive strengthening

As we have seen, the alternatives in an inquisitive proposition, in particular those expressed by disjunctive sentences, often *overlap*. For instance, the proposition expressed by $p \vee q$ contains two alternatives: one consists of all worlds where p is true, and the other of all worlds where q is true. These two alternatives overlap because each of them contains worlds where p and q are both true.

On the other hand, since alternatives are defined in inquisitive semantics as the maximal elements of a proposition, one alternative can never be fully *contained* in another (otherwise it would not be a maximal element). Thus, while the notion of alternativehood in inquisitive semantics is more liberal than in *partition semantics* (Groenendijk and Stokhof, 1984), where alternatives have to be mutually exclusive, it is stricter than in *alternative semantics* (e.g., Hamblin, 1973; Kratzer and Shimoyama, 2002; Alonso-Ovalle, 2006), where alternatives cannot only overlap, but one alternative can also be fully contained in another. Thus, there is a hierarchy of stricter and more liberal notions of alternativehood, with partition semantics and alternative semantics on the far ends of the spectrum and inquisitive semantics somewhere in the middle.[20]

Given that overlapping alternatives are allowed in inquisitive semantics, it is natural to consider an operation that strengthens any given proposition in such a way that the overlap between the alternatives that it contains is removed. As a result, the alternatives become mutually exclusive—they come to satisfy a stricter notion of alternativehood.

We will denote this exclusive strengthening operation as $\times$, and we will denote the proposition that results from applying $\times$ to a given input proposition $[\varphi]$ as $[\varphi]^\times$. Moreover, for any φ we use $\textsc{alt}(\varphi)$ to denote the set of alternatives in $[\varphi]$. It is straightforward to see how $\times$ should be defined: it should remove from $[\varphi]$ any information states that are compatible with more than one alternative in $\textsc{alt}(\varphi)$.[21]

$$[\varphi]^\times := \{s \in [\varphi] \mid \text{there are no } \alpha, \beta \in \textsc{alt}(\varphi) \text{ such that } \alpha \neq \beta, s \cap \alpha \neq \emptyset, \text{ and } s \cap \beta \neq \emptyset\}$$

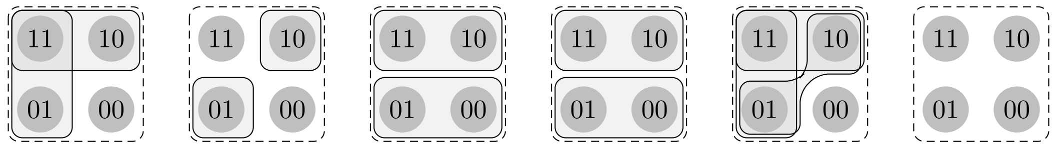
In InqP, the meaning of a sentence consists of two elements: its presupposition, and the proposition that it expresses. We assume that $\times$ only affects the proposition that a sentence expresses, leaving the presupposition unchanged.

$$[\![\varphi]\!]^\times := \langle \mathsf{presup}(\varphi), [\varphi]^\times \rangle$$

Finally, in order to be able to express exclusive strengthening in our logical language, we add a one-place connective, $\boxplus$. Prefixing this connective to a sentence φ gives a new sentence, $\boxplus\varphi$, whose

[20] Roelofsen (2013); Ciardelli *et al.* (2013); Ciardelli (2014); Ciardelli *et al.* (2016); Ciardelli and Roelofsen (2017) discuss a number of theoretical and empirical advantages of this intermediate notion of alternativehood.

[21] This definition is appropriate as long as every element of $[\varphi]$ is contained in a *maximal element*, i.e., an alternative in $[\varphi]$. This holds for all the examples that we will be concerned with. However, it does not hold in general (Ciardelli, 2009). In principle, $[\varphi]$ may have an infinite sequence of ever larger elements, without a maximal one. In order to deal with such cases in a satisfactory way, the notion of alternatives assumed here has to be generalized. Appendix **??** shows how to do this in a natural way; see also Theiler (2014, Appendix A) for a similar proposal.



(a) $p \vee q$ (b) $\boxplus(p \vee q)$ (c) $p \vee \neg p$ (d) $\boxplus(p \vee \neg p)$ (e) $(p \vee q) \vee (p \leftrightarrow \neg q)$ (f) $\boxplus((p \vee q) \vee (p \leftrightarrow \neg q))$

Figure 8: Exclusive strengthening applied to several propositions.

meaning is $[\![\varphi]\!]^{\times}$:

$$[\![\boxplus\varphi]\!] \quad := \quad [\![\varphi]\!]^{\times}$$

Now let us consider some examples to see $\times$ in action. Figures 8(a)-8(b) show the effect of applying $\times$ to $[\![p \vee q]\!]$, already described informally above: the overlap between the two alternatives is removed. Figures 8(c)-8(d) show that if the alternatives in the input proposition are already mutually exclusive, as in the case of $[\![p \vee \neg p]\!]$, then applying $\times$ does not have any effect. Finally, Figures 8(e)-8(f) show that if the alternatives in the input proposition are such that neither of them contains 'a world of its own', i.e., a world that is not contained in any other alternative, as in the case of $[\![(p \vee q) \vee (p \leftrightarrow \neg q)]\!]$ (pronounced as 'p or q or exactly one of the two'), then applying $\times$ results in the absurd proposition $\{\emptyset\}$, expressed by contradictory sentences. We will see that this behavior of $\times$ leads to welcome predictions in the analysis of declarative and interrogative lists involving exclusive strengthening.

Various exclusive and exhaustive strengthening operators have been proposed in the literature (e.g., Groenendijk and Stokhof, 1984; van Rooij and Schulz, 2004; Menéndez-Benito, 2005; Aloni, 2007; Fox, 2007; Alonso-Ovalle, 2008; Balogh, 2009; Chierchia *et al.*, 2012; Aloni and Ciardelli, 2013) to account for a variety of phenomena ranging from free choice effects under modals and in imperatives to the exhaustive interpretation of answers to questions. The operation that we have defined here is closest in nature to an operation that is used in Theiler (2014); Roelofsen *et al.* (2014) to derive the exhaustive interpretation of *wh*-questions (rather than answers).[22] On the other hand, it is quite different—though of course still very much in the same spirit—from exclusive and exhaustive strengthening operations that have been defined in previous work on alternative questions (Rawlins, 2008; Biezma, 2009; Roelofsen and van Gool, 2010; Pruitt and Roelofsen, 2011; Biezma and Rawlins, 2012). For one thing, these previous works all assume a more liberal notion of alternatives, allowing for one alternative to be contained in another, which clearly calls for a different operation of exclusive strengthening. There are further interesting differences between the various earlier proposals as well. Once our account of declarative and interrogative lists is in place we will discuss some examples that show where the different notions of exclusive strengthening come apart. We will argue that the notion we have defined above, besides being a very natural notion in the setting of inquisitive semantics, is also the one that yields the best empirical predictions.

5 Back to the data

5.1 From form to meaning

We are now ready to connect the semantic operations that we have discussed to the elements that we take to play a crucial role in the syntactic representation of declarative and interrogative lists: classifiers, complementizers, and disjunction. We will do this by specifying rules for translating the relevant syntactic representations into our logical language. We will first consider the body of a list, and after that turn to the list classifiers. Recall that the body of a list consists of one or more list

[22]There is in fact a way to unify the two operations entirely, but that would require some amendments of other components of the theory developed in Theiler (2014); Roelofsen *et al.* (2014), which would lead us too far afield here.

items, separated by disjunction. Every list item, in turn, is a full clause headed by a declarative or interrogative complementizer ($\mathrm{C}_{\text{DECL/INT}}$). The rest of the clause is a tense phrase (TP), which may itself contain a disjunction. Finally, the E operator may in principle be attached to any disjunctive phrase (we will propose a semantic constraint on the distribution of the E operator in Section 5.4, but as far as our syntax is concerned there are no constraints).

The translation procedure is very straightforward. Any disjunction is translated as $\vee$, no matter whether it separates two list items or occurs within one of the list items, and any occurrence of E is translated as $\boxplus$. Every complementizer, be it declarative or interrogative, is translated as !. The rationale for this is that every list item is seen, intuitively speaking, as one block, i.e., as contributing a single alternative to the proposition expressed by the list as a whole. This is ensured by applying !, which turns any proposition A into a proposition with a single alternative, $\bigcup A$. Otherwise the procedure is completely standard. Thus, the body of a list is translated according to the rule in (98), where $\varphi_1, \ldots, \varphi_n$ are standard translations of $\mathrm{TP}_1, \ldots, \mathrm{TP}_n$ into the language of propositional logic, with the proviso that E is translated as $\boxplus$:

(98) *Rules for translating the body of a list*:

a. $[[\mathrm{C}_{\text{DECL/INT}}\ \mathrm{TP}_1] \text{ or } \ldots \text{ or } [\mathrm{C}_{\text{DECL/INT}}\ \mathrm{TP}_n]] \quad \rightsquigarrow \quad !\varphi_1 \vee \ldots \vee !\varphi_n$

b. $[\mathrm{E}\ [[\mathrm{C}_{\text{DECL/INT}}\ \mathrm{TP}_1] \text{ or } \ldots \text{ or } [\mathrm{C}_{\text{DECL/INT}}\ \mathrm{TP}_n]]] \quad \rightsquigarrow \quad \boxplus(!\varphi_1 \vee \ldots \vee !\varphi_n)$

Let us illustrate these rules by means of examples (85)-(87), repeated below (the syntactic representations of these sentences were given on page 20).

(85) Does Igor speak English↑ or does he speak French↑?

(86) Does Igor speak English-or-French↑?

(87) Igor speaks English↓.

If we translate *Igor speaks English* as p and *Igor speaks French* as q, then we get the following translations for the bodies of these lists:

(99) $[\mathrm{C}_{\text{INT}}$ Igor speaks English$]$ or $[\mathrm{C}_{\text{INT}}$ Igor speaks French$]$ $\rightsquigarrow$ $!p \vee !q$ $(\equiv p \vee q)$

(100) $[\mathrm{C}_{\text{INT}}$ Igor speaks English or French$]$ $\rightsquigarrow$ $!(p \vee q)$

(101) $[\mathrm{C}_{\text{DECL}}$ Igor speaks English$]$ $\rightsquigarrow$ $!p$ $(\equiv p)$

Now let us turn to the list classifiers. To specify their semantic contribution it is convenient to use some notation and terminology from type theory.[23] Recall that in inquisitive semantics, propositions are sets of sets of possible worlds, i.e., objects of type $\langle\langle s,t\rangle,t\rangle$. Let us abbreviate this type as T. Now, we will treat DECL and INT as *propositional modifiers*, i.e., as functions that take a proposition as their input, and deliver another proposition as their output. This means that DECL and INT are of type $\langle T,T\rangle$. On the other hand, we will treat OPEN and CLOSED as functions that take two inputs, first a proposition and then a propositional modifier, and deliver a proposition as their output. So OPEN and CLOSED are of type $\langle T,\langle\langle T,T\rangle,T\rangle\rangle$. It will become clear in a moment why OPEN and CLOSED are treated as having this somewhat more complex type, rather than simply as propositional modifiers of type $\langle T,T\rangle$, like DECL and INT. First, we need to look at each of the classifiers in somewhat more detail.

First consider DECL. We will treat DECL as making a list purely informative, i.e., as *eliminating inquisitiveness*. This effect can be achieved straightforwardly by treating DECL as a function that

[23]We will only use some type-theoretical notation here in the meta-language to describe functions (see, e.g., Heim and Kratzer, 1998). A more rigorous approach would be to extend the InqP system to a full-fledged type theoretic framework. We leave this step implicit here because it would involve quite some technicalities which are orthogonal to our present concerns, and which may obscure the essence of our proposal. See Theiler (2014) and Ciardelli *et al.* (2016) for a type theoretical extension of InqB (without presuppositions).

takes the body of a list as its input, let's call this B, and applies the non-inquisitive projection operator ! to it, returning $!B$. Using type-theoretic notation, this can be formulated concisely as follows:

(102) DECL $\rightsquigarrow$ $\lambda B.!B$

Next, consider INT. We treat interrogativity as having two effects. First, whenever possible, it *ensures inquisitiveness*. This is done by applying a conditional variant of the ? operator, which we will denote here as $\langle ? \rangle$. If the body of the list that $\langle ? \rangle$ takes as its input is not yet inquisitive, then ? is applied to it. On the other hand, if the body of the list is already inquisitive, then it is left untouched. The only case in which this procedure does *not* yield an inquisitive output is when the body of the list is a tautology or a contradiction. In these two cases $\langle ? \rangle$ yields a tautology, which is not inquisitive. In all other cases, it ensures inquisitiveness.

The second function of interrogativity is to *ensure non-informativity*. This is done by applying the † operator, which turns the at-issue informative content of the body of the list, if any, into a presupposition. Thus, we assume the following treatment of INT:

(103) INT $\rightsquigarrow$ $\lambda B.\dagger\langle ? \rangle B$

Finally, let us consider OPEN and CLOSED. Intuitively speaking, we treat these classifiers as encoding whether the list is left 'open ended' or whether it is 'finished' and ready to be 'sealed off'. The role of CLOSED is to mark the list as being finished, and to allow DECL or INT, whichever is present, to 'seal off' the list by projecting the proposition expressed by the body of the list onto one of the axes of the logical space, trivializing either inquisitive or informative content. Thus, CLOSED is treated as a function that takes two arguments—a proposition B provided by the body of the list, and a propositional modifier M provided by DECL or INT—and returns the proposition that is obtained by applying M to B:[24]

(104) CLOSED $\rightsquigarrow$ $\lambda B.\lambda M.M(B)$

On the other hand, the role of OPEN is to mark the list as being open-ended. It prevents DECL/INT from sealing off the body of the list, and instead applies the ? operator, which adds the complement of $\bigcup B$ as an additional alternative. This captures the characteristic semantic property of open lists, which is that they always leave open the possibility that none of the given list items holds. Thus, just like CLOSED, OPEN is also treated as a function taking two arguments—a proposition B provided by the body of the list, and a propositional modifier M provided by DECL or INT. However, unlike CLOSED, it applies ? to B and prevents M from becoming operative.

(105) OPEN $\rightsquigarrow$ $\lambda B.\lambda M.?B$

In total there are four types of lists, each featuring a combination of DECL/INT and OPEN/CLOSED. From the treatment of these items given above, it follows that the four types of lists are translated into our logical language as specified in (106) below, where in each case φ stands for the translation of the body of the list, obtained according to the rule in (98) above.

(106) *Combined rules for translating list classifiers*:

a. [DECL CLOSED [body]] $\rightsquigarrow$ $!\varphi$
b. [DECL OPEN [body]] $\rightsquigarrow$ $?\varphi$
c. [INT CLOSED [body]] $\rightsquigarrow$ $\dagger\langle ? \rangle\varphi$
d. [INT OPEN [body]] $\rightsquigarrow$ $?\varphi$

[24]Exactly the same results would be obtained if we treated CLOSED simply as the identity function on propositions, $\lambda B.B$. We prefer the slightly more complex entry given below because it directly reflects the intuition that CLOSED marks a list as being finished and lets it be sealed off by DECL or INT, and also because in this way it is of the same semantic type as OPEN, which will be treated right below.

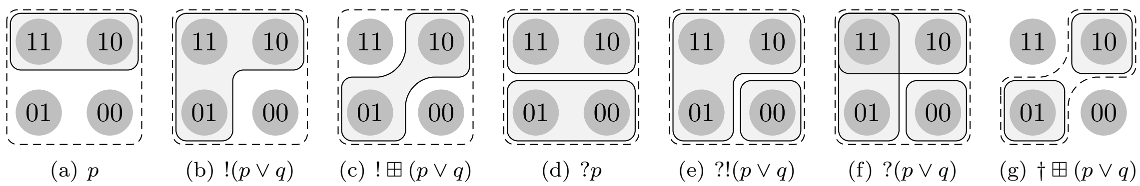


Figure 9: Propositions expressed by declarative and interrogative lists.

The rules in (98) and (106) together give a complete specification of how to translate the syntactic representations of declarative and interrogative lists in English into our logical language, and thereby provide a semantic analysis of such lists. Below we provide a number of examples that are representative for the types of sentences that we are concerned with. In the translations of these examples, p stands for *Igor speaks English* and q for *Igor speaks French*. In each case we provide the direct translation and also a simpler formula that is semantically equivalent in InqP to the direct translation. The propositions expressed by these simplified translations are all depicted in Figure 9.

—Closed delaratives—	*Translation*:	*Simplified*:
Igor speaks English↓.	$!!p$	p
Igor speaks English-or-French↓.	$!!(p \vee q)$	$!(p \vee q)$
Igor speaks English↑ or he speaks French↓.	$!\boxplus(!p \vee !q)$	$!\boxplus(p \vee q)$
—Open declaratives—		
Igor speaks English↑.	$?!p$	$?p$
Igor speaks English-or-French↑.	$?!(p \vee q)$	$?!(p \vee q)$
Igor speaks English↑ or he speaks French↑.	$?(!p \vee !q)$	$?(p \vee q)$
—Open interrogatives—		
Does Igor speak English↑?	$?!p$	$?p$
Does Igor speak English-or-French↑?	$?!(p \vee q)$	$?!(p \vee q)$
Does Igor speak English↑ or does he speak French↑?	$?(!p \vee !q)$	$?(p \vee q)$
—Closed interrogatives—		
Does Igor speak English↓?	$\dagger?!p$	$?p$
Does Igor speak English-or-French↓?	$\dagger?!(p \vee q)$	$?!(p \vee q)$
Does Igor speak English↑ or does he speak French↓?	$\dagger\boxplus(!p \vee !q)$	$\dagger\boxplus(p \vee q)$

Note that the mapping from forms to meanings is not a one-to-one mapping: various types of lists are given the same translation and are thus associated with the same proposition. For instance, the open polar interrogative in (107a), the closed polar interrogative in (107b), and the open declarative in (107c) are all translated as $?p$, which expresses the proposition in Figure 9(d).

(107) a. Does Igor speak English↑? — open interrogative
b. Does Igor speak English↓? — closed interrogative
c. Igor speaks English↑. — open declarative

This is as it should be, because in terms of informative, inquisitive, and presuppositional content these sentences are indeed the same: they all raise the issue whether Igor speaks English, without providing or presupposing any information. However, as observed in Section 2, there *is* a contrast between (107a) on the one hand and (107b-c) on the other. Namely, while (107a) is seen as the *default* way of expressing the issue whether Igor speaks English, (107b-c) are perceived as *marked* ways of doing so, and the range of contexts in which they can be felicitously used is restricted.

The same point applies to the three sentences in (108), which are the disjunctive counterparts of those in (107):

(108) a. Does Igor speak English-or-French↑? — open interrogative
b. Does Igor speak English-or-French↓? — closed interrogative
c. Igor speaks English-or-French↑. — open declarative

These sentences are all translated as $?!(p \vee q)$ and thus associated with the proposition in Figure 6(d). Again, the open interrogative in (108a) is the default way of expressing this proposition, while the closed interrogative in (108b) and the open declarative in (108c) are marked ways of doing so.

Finally, the same point also applies to the two sentences in (109), which are both translated as $?(p \vee q)$.

(109) a. Does Igor speak English↑ or does he speak French↑? — open interrogative, two items
b. Igor speaks English↑ or he speaks French↑. — open declarative, two items

The interrogative is again the default way of expressing the given meaning, while the declarative is marked—indeed, in this case it is difficult to think of any context at all in which it could be used felicitously.

Thus, a general distinction can be made between *marked* and *unmarked* sentence types. We will first discuss the unmarked cases in more detail, in Section 5.2, and then move on to the marked cases in Section 5.3.

5.2 Unmarked cases

We start with the simplest unmarked case, namely the non-disjunctive closed declarative in (110):

(110) Igor speaks English↓. — closed declarative

This sentence has the following logical form:

(111) [DECL [CLOSED [C_{DECL} Igor speaks English]]]

The translation of this logical form is $!!p$, which can be simplified to just p. The meaning of this sentence is depicted in Figure 9(a). It is correctly predicted that the sentence provides the information that Igor speaks English, without requesting or presupposing any additional information.

Next, consider the disjunctive closed declarative in (112):

(112) Igor speaks English-or-French↓. — closed declarative with disjunction

This sentence has the following logical form:

(113) [DECL [CLOSED [C_{DECL} Igor speaks English or French]]]

The simplified translation of this logical form is $!(p \vee q)$, whose meaning is depicted in Figure 6(b). The sentence is correctly predicted to provide the information that Igor speaks English or French, without requesting or presupposing any additional information. The alternatives generated by the disjunction are 'flattened' by the declarative complementizer because the disjunction occurs within a single list item, as witnessed by the fact that it is pronounced in a single intonational phrase.

What if the disjunction separates two list items, still in a closed declarative? This case is exemplified by:

(114) Igor speaks English↑ or he speaks French↓. closed declarative, two items

This sentence has two possible logical forms, one with the E operator and one without:

(115) [DECL [CLOSED [E [[C_{DECL} Igor speaks English] or [C_{DECL} he speaks French]]]]

(116) [DECL [CLOSED [[C_{DECL} Igor speaks English] or [C_{DECL} he speaks French]]]

Recall from Section 3 that the presumed prosodic effects of E align with those of CLOSED in this configuration, which makes it difficult to discern, purely based on the prosody of the sentence, whether E is present in its logical form or not. As already anticipated in Section 3, we assume that the interpretation process is guided by the *strongest meaning hypothesis* in such cases: the logical form that yields the stronger semantic interpretation—which is always the one where E is present—is prefered.

The simplified translation of (115) is $!\boxplus(p \vee q)$, whose meaning is depicted in Figure 9(c), and the simplified translation of (116) is $!(p \vee q)$, whose meaning is depicted in Figure 6(b). Note that, indeed, the former entails the latter and is therefore prefered. The proposition expressed by $!\boxplus(p \vee q)$ contains a single alternative, which means that the sentence is predicted to be non-inquisitive. However, the alternatives generated by the disjunction are flattened by DECL this time, not by the declarative complementizer, as was the case in (112). As for informativeness, it is predicted that (114) does not just carry the information that Igor speaks *at least* one of the two languages, but that he speaks *exactly one*. As remarked in Section 2, we take it that, with the given intonation pattern, this is indeed a strict entailment of the sentence and not just a conversational implicature. Thus, (114) is predicted to be strictly more informative than (112), as desired.

Now let us turn to interrogative lists. The simplest unmarked case here is the open polar interrogative in (117).

(117) Does Igor speak English↑? open interrogative

This sentence has the following logical form:

(118) [INT [OPEN [C_{INT} does Igor speak English]]]

The simplified translation of this logical form is $?p$, whose meaning is depicted in Figure 9(d). The sentence is predicted to request information as to whether Igor speaks English, and it not predicted to provide or presuppose any information.

Next, consider the disjunctive open interrogative in (119).

(119) Does Igor speak English-or-French↑? disjunctive open interrogative

This sentence has the following logical form:

(120) [INT [OPEN [C_{INT} does Igor speak English or French]]]

The simplified translation of this logical form is $?!(p \vee q)$, whose meaning is depicted in Figure 9(e). Again, the sentence is predicted to be inquisitive, but not informative and not presuppositional. In order to resolve the issue that it raises, the conversational participants either need to establish that Igor indeed speaks at least one of the two languages, or that he does not speak either.

Next, consider the open interrogative in (121), where the disjunction separates two list items.

(121) Does Igor speak English↑ or does he speak French↑? open interrogative, two items

This sentence has the following logical form:

(122) [INT [OPEN [[C_{INT} does Igor speak English] or [C_{INT} does he speak French]]]]

The simplified translation of this logical form is $?(p \vee q)$, whose meaning is depicted in Figure 9(f). As desired, the sentence is predicted to be more inquisitive than (119). Namely, in order to resolve the issue that it raises, it is not sufficient to establish that Igor speaks at least one of the two languages. Rather, it either needs to be established that Igor speaks English, or that he speaks French, or that he speaks neither.

Finally, consider the closed interrogative in (123), again with two list items.

(123) Does Igor speak English↑ or does he speak French↓? closed interrogative, two items

This sentence, just like the closed declarative in (114), has two possible logical forms, one with the E operator and the other without:

(124) [INT [CLOSED [E [[C_{INT} does Igor speak English] or [C_{INT} does he speak French]]]]]

(125) [INT [CLOSED [[C_{INT} does Igor speak English] or [C_{INT} does he speak French]]]]

The strongest meaning hypothesis again favors the logical form where E is present, and the simplified translation of this logical form is $\dagger\times(p \vee q)$, whose meaning is depicted in Figure 9(g). The disjunction generates two alternatives, $\{11, 10\}$ and $\{11, 01\}$. These alternatives are then strengthened by $\boxplus$, so that they become mutually exclusive. This yields a proposition containing $\{10\}$ and $\{01\}$ as its two alternatives. Since this proposition is already inquisitive, INT does not need to apply the ? operator; it only needs to ensure non-informativeness by applying the † operator. This yields the presupposition that exactly one of p and q holds.

Thus, the basic semantic properties of unmarked declarative and interrogative lists that we set out to account for are now derived in a straightforward and principled way.

5.3 Marked cases

We now turn to the marked cases, which we consider to be the following:

(126) Does Igor speak English↓? closed interrogative

(127) Igor speaks English↑. open declarative

(128) Does Igor speak English-or-French↓? disjunctive closed interrogative

(129) Igor speaks English-or-French↑. disjunctive open declarative

(130) Igor speaks English↑ or he speaks French↑. open declarative, two items

Our aim here will just be to account for the marked status of these sentences—we will *not* try to characterize their special discourse effects or the exact range of contexts in which they could be felicitously used. The general idea that we will pursue, familiar from much work in neo-Gricean pragmatics and optimality theory (see, e.g., Horn, 1984; Blutner, 2000), is that an expression is perceived as marked if there is another expression that has the same meaning and is, other things being equal, better suited to express that meaning. One reason for this may be that the latter expression is easier to produce; another reason may be that it has a greater chance of being interpret as intended. This second reason will be most relevant for us.

Notice that every sentence in (126)-(130) either involves the classifier combination [CLOSED INT] or the combination [OPEN DECL]. Vice versa, every type of list with one of these two classifier combinations is represented in (126)-(130), except for closed interrogatives with multiple list items, i.e., alternative questions—we will return to this momentarily. Quite generally, then, there is something marked about closed interrogative and open declarative lists. Why would this be? We propose that the source of this markedness lies in the fact that these kinds of lists are generally in competition with open interrogative lists, and that the latter are generally prefered because they maximize the chance of being interpreted as intended. This is because, in many configurations, OPEN and INT have precisely the same semantic effect, and even more importantly, in these configurations the same overall interpretation would result if either OPEN or INT were to be *mis*interpreted as CLOSED or DECL, respectively.

Let us look at an example to make this more concrete. Consider the closed interrogative in (126). The simplified translation of this sentence is $?p$, which is also the simplified translation of the open interrogative in (131).

(131) Does Igor speak English↑? open interrogative

Now suppose that someone hears this sentence in a conversation and has to determine its meaning. If all goes well, the sentence is recognized as an open interrogative—through the interrogative word order and the final rise. However, even if the sentence is mistakenly parsed as an open *declarative*, or as a *closed* interrogative, the same interpretation would still be derived. Thus, open interrogatives are very robust: if one piece breaks, the whole construction still functions as intended. This is not the case for the closed interrogative in (126). If this sentence is mistakenly parsed as a closed *declarative*, the intended interpretation would not be obtained. This explains the marked nature of this sentence type.

Exactly the same reasoning applies to the open declarative in (127). This sentence also has $?p$ as its simplified translation, so it is also in competition with the open interrogative in (131). And again, it does not have the same robustness as the open interrogative, because if it is mistakenly parsed as a *closed* declarative, the intended interpretation is not obtained. This explains its marked nature.

The other three cases can be explained analogously: (128) and (129) are in competition with the open interrogative in (132), and (130) is in competition with the open interrogative in (133). In all cases the open interrogative is favored because of its supreme robustness.

(132) Does Igor speak English-or-French↑? open interrogative

(133) Does Igor speak English↑ or does he speak French↑? open interrogative, two items

Finally, let us return to the case of alternative questions, i.e., closed interrogatives with multiple items, which are *not* marked, even though closed interrogatives with a single item are, whether they contain a disjunction or not (see examples (126) and (128) above). The reason for this is that closed interrogative lists with multiple items are *not* generally equivalent with the corresponding open interrogative lists. So in this case there is no competition between the two types of lists.

To make this concrete again, consider the closed interrogative in (134).

(134) Does Igor speak English↑ or does he speak French↓? closed interrogative, two items

The simplified translation of this sentence is $\dagger \boxplus (p \vee q)$. Thus, it does not have the same meaning as the corresponding open interrogative in (133), nor is there any other competing list type. This explains its unmarked nature.

5.4 Restricted distribution of exclusive strengthening

We observed in Section 2.5 that prosodically marked exclusive strengthening is licensed in the scope of upward monotonic operators, but not in the scope of downward monotonic or non-monotonic operators, and not in polar questions either. We noted that this pattern is reminiscent of NPIs, although the distribution of NPIs is rather complementary: they *are* licensed in polar questions, and they are licensed in the scope of *down*ward monotonic operators rather than upward monotonic ones. In the scope of non-monotonic operators, neither NPIs nor prosodically marked exclusive strengthening are licensed.

One of the most influential ideas in the literature on NPIs, originating in Kadmon and Landman (1993) and further developed in Krifka (1995) and Chierchia (2004), among others, is that an

NPI is only licensed if its 'domain widening effect' strengthens the overall semantic content of the construction that it is part of. Since domain widening itself is a weakening operation, a downward monotonic operator is needed to turn this weakening effect into a strengthening one. Upward monotonic and non-monotonic operators do not have this ability and therefore do not license NPIs in their scope.

We propose that in the case of exclusive strengthening we have exactly the reverse situation: as the name suggests, exclusive strengthening itself has a strengthening effect. Upward monotonic operators preserve this strengthening effect, but downward monotonic or non-monotonic operators cancel it. Thus, if we postulate that prosodically marked exclusive strengthening is licensed only if it strengthens the semantic content of the construction that it is part of, then some important aspects of its distribution are accounted for (we did not deal with the case of polar questions yet). We formulate this constraint as follows.

(135) **Strengthening condition**

Let L be a logical form, and let E be an occurrence of the exclusive strengthening operator in L. Then L is licensed only if the semantic value of any constituent C in L that contains E entails the semantic value that would be assigned to that constituent without E.

We are assuming the notion of entailment as defined in inquisitive semantics, which measures both informative and inquisitive strength (see page 26), rather than the classical notion of entailment, which measures just informative content. We will see that this is crucial when we get to questions.

Let us consider some concrete examples to see the constraint in action. One note: when checking whether a given logical form containing E satisfies the strengthening condition, we will not be looking at all constituents in that logical form containing E, but rather just at those which express propositions, since the notion of entailment that we are operating with here only applies to full propositions. It is in principle straightforward to generalize the notion to apply to constituents of any conjoinable type (Theiler, 2014; Ciardelli *et al.*, 2016), but this will not be necessary for our purposes.

First consider a case where E is attached to a disjunction in the scope of an upward monotonic operator.

(136) [DECL [CLOSED [C_{DECL} every student takes [E [Spanish or Chinese]]]]]

The simplified translation of the body of the list, as well as that of the entire structure, is:

(137) $!(\forall x.(\mathsf{Student}(x) \to \boxplus(\mathsf{Spanish}(x) \vee \mathsf{Chinese}(x))))$

Without E, it would be:

(138) $!(\forall x.(\mathsf{Student}(x) \to (\mathsf{Spanish}(x) \vee \mathsf{Chinese}(x))))$

The proposition expressed by (137) contains all information states consisting of worlds in which every student takes *exactly* one of the two languages. The proposition expressed by (138) on the other hand contains all information states consisting of worlds in which every student takes *at least* one of the two languages. The first proposition entails (is included in) the second, which means that the logical form in (136) is licensed.

Now consider a case where E is attached to a disjunction in the scope of an downward monotonic operator.

(139) [DECL [CLOSED [C_{DECL} no student takes [E [Spanish or Chinese]]]]]

The simplified translation of the body of the list, as well as that of the entire structure, is:

(140) $!(\neg\exists x.(\mathsf{Student}(x) \wedge \boxplus(\mathsf{Spanish}(x) \vee \mathsf{Chinese}(x))))$

Without E, it would be:

(141) $!(\neg\exists x.(\mathsf{Student}(x) \wedge (\mathsf{Spanish}(x) \vee \mathsf{Chinese}(x))))$

The proposition expressed by (140) contains all information states consisting of worlds in which no student takes *exactly* one of the two languages. The proposition expressed by (141) contains all information states consisting of worlds in which no student takes *any* of the two languages. Suppose w is a world where there is just one student, John, who takes *both* languages. Then the information state $\{w\}$ is included in $[(140)]$ but not in $[(141)]$. Thus, $[(140)] \nsubseteq [(141)]$, i.e., the first does not entail the second (rather there is an entailment in the other direction). This means that the logical form in (142) is *not* licensed, as desired.

Finally, consider a case where E is attached to a disjunction in the scope of an non-monotonic operator.

(142) [DECL [CLOSED [$\mathrm{C}_{\mathrm{DECL}}$ exactly one student takes [E [Spanish or Chinese]]]]]

The simplified translation of the body of the list, as well as that of the entire structure, is:

(143) $!(\exists x.\forall y.((\mathsf{Student}(y) \wedge \boxplus(\mathsf{Spanish}(y) \vee \mathsf{Chinese}(y))) \leftrightarrow x = y))$

Without E, it would be:

(144) $!(\exists x.\forall y.((\mathsf{Student}(y) \wedge \boxplus(\mathsf{Spanish}(y) \vee \mathsf{Chinese}(y))) \leftrightarrow x = y))$

The proposition expressed by (143) contains all information states consisting of worlds in which there is exactly one student who takes *exactly* one of the two languages. The proposition expressed by (144) contains all information states consisting of worlds in which there is exactly one student who takes *at least* one of the two languages. Suppose w is a world where there are two students; the first takes only Spanish but the second takes both Spanish and Chinese. Then $\{w\} \in [(143)]$ but $\{w\} \notin [(144)]$. Thus, $[(143)] \nsubseteq [(144)]$, i.e., the first does not entail the second (in this case, there is no entailment in the other direction either). This means that the logical form in (142) is not licensed, again as desired.

So far we have considered only closed declaratives. Now let us turn to a polar interrogative, which we saw in Section 2.5 does not license prosodically marked exclusive strengthening in its scope, no matter whether the interrogative is open or closed. First consider the open version:

(145) [INT [OPEN [$\mathrm{C}_{\mathrm{INT}}$ does Igor speak [E [English or French]]]]]

The simplified translation of this logical form is (146), and without E it would be (147):

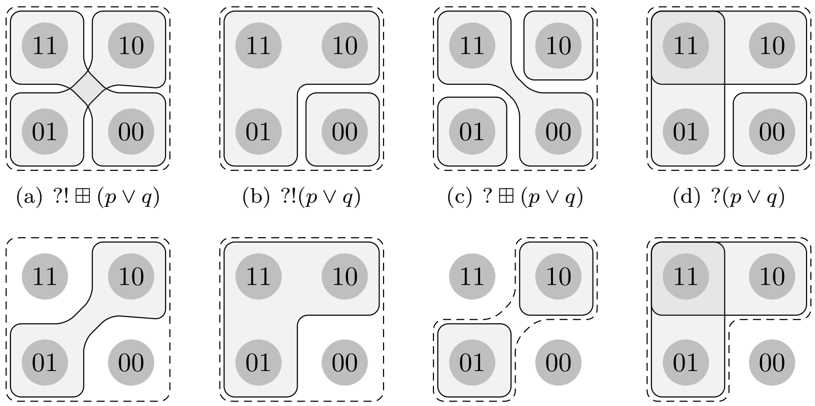
(146) $?! \boxplus (p \vee q)$

(147) $?!(p \vee q)$

The propositions expressed by (146) and (147) are depicted in Figures 10(a) and 10(b), respectively. In order to resolve the issue expressed by (146), it needs to be established whether Igor speaks exactly one of the two languages. One way to do this is to establish that he does *not* speak exactly one of the two languages: this would lead us to the information state $\{11, 00\}$, which is indeed part of $[(146)]$ as can be seen in Figure 10(a). On the other hand, establishing that Igor does not speak exactly one of the two languages would not resolve the issue expressed by (147), as can be seen in Figure 10(b). Thus, $[(146)] \nsubseteq [(147)]$, i.e., the first does not entail the second, which means that the logical form in (145) is not licensed, again as desired.

Interestingly, it is crucial in this case that our notion of entailment measures both informative and inquisitive content. After all, since (146) and (147) are both non-informative, the first *would* entail the second if entailment were cast just in terms of informative strength.

Now let us consider a case were E is attached to a disjunction in a closed polar interrogative.



(a) $?!\boxplus(p \vee q)$ (b) $?!(p \vee q)$ (c) $?\boxplus(p \vee q)$ (d) $?(p \vee q)$

(e) $!\boxplus(p \vee q)$ (f) $!(p \vee q)$ (g) $\dagger\boxplus(p \vee q)$ (h) $\dagger(p \vee q)$

Figure 10: The effect of exclusive strengthening in various configurations.

(148) [INT [CLOSED [C_{INT} does Igor speak [E [English or French]]]]]

The simplified translation of this logical form is (149), and without E it would be (150):

(149) $?!\boxplus(p \vee q)$

(150) $?!(p \vee q)$

Note that these translations are exactly the same as in the case of the open polar interrogative that we just discussed, although they are derived in a different way: in the case of an open interrogative it is OPEN that contributes the ? operator while in the case of a closed interrogative this is done by INT. Since the result is the same, however, (148) is predicted to violate the strengthening condition, just like (145), as desired.

Exactly the same reasoning also applies to an open declarative like (151).

(151) [DECL [OPEN [C_{DECL} Igor speaks [E [English or French]]]]]

The translations that need to be compared are again the same—this time the ? operator is contributed again by OPEN, as in (145). Thus, the strenthening condition rules out this logical form as well.

We have seen, then, that among all mono-clausal lists only closed declaratives license exclusive strengthening. And even in those, the presence of downward monotonic or non-monotonic operators prevents exclusive strengthening from being licensed. We have illustrated this here with the downward monotonic quantifier *no student* and the non-monotonic quantifier *exactly one student*. Recall from Section 2.5 that the phenomenon also manifests itself with other types of constructions, like attitude verbs, relative clauses, and conditionals. These can be accounted for in exactly the same way, although in order to deal with some of these constructions (e.g., attitude verbs) our first-order system would of course have to be extended (see Ciardelli and Roelofsen, 2015; Theiler, 2014; Roelofsen *et al.*, 2014).

Now let us consider the distribution of exclusive strengthening in bi-clausal lists. In particular, let us see in which kinds of bi-clausal lists E can be attached to the full body of the list, a disjunction of two clauses. In the case of open lists, no matter whether they are declarative or interrogative, it is again the ? operator that prevents E from being licensed. To see this consider the following example, an open interrogative; the case of open declarative is completely analogous.

(152) [INT [OPEN [E [[C_{INT} does Igor speak English] or [C_{INT} does he speak French]]]]]

The simplified translation of this logical form is (153), and without E it would be (154):

(153) $? \boxplus (p \vee q)$

(154) $?(p \vee q)$

The propositions expressed by (153) and (154) are depicted in Figures 10(c) and 10(d), respectively. From these figures it is immediately clear that the first does not entail the second—for instance, the information state $\{11, 00\}$ is included in $[\![(153)]\!]$ but not in $[\![(154)]\!]$. Thus, the logical form in (152) is not licensed.

Next, let us consider closed bi-clausal lists, starting with a declarative.

(155) [DECL [CLOSED [E [[C_{DECL} Igor speaks English] or [C_{DECL} he speaks French]]]]]

The simplified translation of this logical form is (156), and without E it would be (157):

(156) $! \boxplus (p \vee q)$

(157) $!(p \vee q)$

The propositions expressed by (156) and (157) are depicted in Figures 10(e) and 10(f), respectively. This time, the first *does* entail the second. So prosodically marked exclusive strengthening is predicted to be licensed in this configuration. This is a desirable result since, as we observed earlier, bi-clausal closed declaratives can indeed be pronounced with the relevant prosody, and if they are pronounced in this way they imply that exactly one of the disjuncts holds, even in contexts in which this implication cannot be derived as a conversational implicature.

Finally, let us consider a bi-clausal closed interrogative with exclusive strengthening, i.e., an alternative question.

(158) [INT [CLOSED [E [[C_{INT} does Igor speak English] or [C_{INT} does he speak French]]]]]

The simplified translation of this logical form is (159), and without E it would be (160):

(159) $\dagger \boxplus (p \vee q)$

(160) $\dagger(p \vee q)$

The propositions expressed by (159) and (160) are depicted in Figures 10(g) and 10(h), respectively. Again, the first entails the second, which means that exclusive strengthening is licensed in this configuration. Notice the contrast between this case and the *mono*-clausal closed interrogative in (148), which did not license exclusive strengthening. The contrast is explained by the behavior of INT. Recall that one of the tasks of INT is to *ensure inquisitiveness*. In a mono-clausal closed interrogative, INT always operates on a proposition that is not inquisitive by itself. Thus, it applies the ? operator to generate an additional alternative, and this is what prevents exclusive strengthening from being licensed. On the other hand, in a bi-clausal closed interrogative, INT typically operates on a proposition that *is* already inquisitive. Thus, in this case it does not apply the ? operator, and does not prevent exclusive strengthening from being licensed.

In sum, then, while in mono-clausal lists exclusive strengthening may only be licensed if the list is a closed declarative, in bi-clausal lists it may be licensed both in closed declaratives and in closed interrogatives. It is worth emphasizing again that in order to obtain these results, it is crucial that we adopt a notion of entailment that is sensitive to both informative and inquisitive strength, rather than the classical notion which is confined to measuring informative strength.

5.5 Structurally indeterminate cases

We saw in Section 2.3 that structurally indeterminate lists largely behave like bi-clausal ones, although in a restricted class of examples, namely in closed declarative lists which contain a scopal element interacting with the disjunction, we found a contrast in interpretation between indeterminate lists and bi-clausal ones. Our theory accounts for this pattern without any further stipulations. To see this, let us go through the relevant cases one by one.

First consider the structurally indeterminate closed declarative in (161):

(161) Igor speaks English↑ or French↓. indeterminate closed declarative

Given our syntactic assumptions, this sentence may have the mono-clausal logical form in (162a), but also either of the bi-clausal logical forms in (162b) and (162c).

(162) a. [DECL [CLOSED [$\mathrm{C}_{\textsc{decl}}$ Igor speaks [E [English or French]]]]]
b. [DECL [CLOSED [E [[$\mathrm{C}_{\textsc{decl}}$ Igor speaks English] or [$\mathrm{C}_{\textsc{decl}}$ he speaks French]]]]]
c. [DECL [CLOSED [[$\mathrm{C}_{\textsc{decl}}$ Igor speaks English] or [$\mathrm{C}_{\textsc{decl}}$ he speaks French]]]]

The latter two logical forms are also available for the explicitly bi-clausal sentence in (163); of course this does not hold for the mono-clausal logical form in (162a).

(163) Igor speaks English↑ or he speaks French↓. bi-clausal closed declarative

The simplified translation of (162a) and (162b) is the same, namely $! \boxplus (p \vee q)$. The simplified translation of (162c) is different, namely $!(p \vee q)$. Note that the former entails the latter. Thus, by the strongest meaning hypothesis, both the structurally indeterminate list and the explicitly bi-clausal list are interpreted as $! \boxplus (p \vee q)$, i.e., as implying that Igor speaks *exactly* one of the two languages.

Now let us consider a closed declarative containing a scopal element that interacts with the disjunction.

(164) Every second grade student here takes English↑ or French↓.

Again there are three possible logical forms, one mono-clausal and two bi-clausal; only the latter two are available for the explicitly bi-clausal variant of (164).

(165) a. [DECL [CLOSED [$\mathrm{C}_{\textsc{decl}}$ every second grade student here takes [E [English or French]]]]]
b. [DECL [CLOSED [E [[$\mathrm{C}_{\textsc{decl}}$ every... English] or [$\mathrm{C}_{\textsc{decl}}$ every... French]]]]]
c. [DECL [CLOSED [[$\mathrm{C}_{\textsc{decl}}$ every... English] or [$\mathrm{C}_{\textsc{decl}}$ every... French]]]]

Interestingly, the first and the second logical form no longer have the same translation in this case. Namely, the simplified translation of (174a) is (166a), while that of (168b) is (166b). The logical form in (174b) receives yet another translation, namely that in (166c).

(166) a. $\forall x.(\mathsf{Student}(x) \rightarrow \boxplus(\mathsf{English}(x) \vee \mathsf{French}(x)))$
b. $\boxplus(\forall x.(\mathsf{Student}(x) \rightarrow \mathsf{English}(x)) \vee \forall x.(\mathsf{Student}(x) \rightarrow \mathsf{French}(x)))$
c. $\forall x.(\mathsf{Student}(x) \rightarrow \mathsf{English}(x)) \vee \forall x.(\mathsf{Student}(x) \rightarrow \mathsf{French}(x))$

Now, (166b) entails (166c), which means that, by the strongest meaning hypothesis, the former is favored over the latter. This is the same as in the non-quantificational case discussed above. However, (166a) and (166b) are *logically independent*, i.e., neither one entails the other. Thus, these embody two different readings of (164). The most salient reading is represented by (166a), where the disjunction takes narrow scope w.r.t. the quantifier. The other reading, where disjunction takes wide scope, is represented by (166b). As we observed earlier, this second reading can be made more salient by adding “I don’t remember which”.

Thus, the ambiguity of (164) is accounted for, and it is also predicted that its most salient reading is *not* available for its explicitly bi-clausal counterpart, which cannot have the logical form in (174a).

Now let us turn to a structurally indeterminate closed interrogative. We will immediately consider a case with a quantificational subject; cases with referential subjects behave essentially the same.

(167) Does every second grade student here take English↑ or French↓?

Again our syntax generates three possible logical forms, one mono-clausal and two bi-clausal.

(168) a. [INT [CLOSED [C_{INT} every second grade student here takes [E [English or French]]]]]
b. [INT [CLOSED [E [[C_{INT} every... English] or [C_{INT} every... French]]]]]
c. [INT [CLOSED [[C_{INT} every... English] or [C_{INT} every... French]]]]

However, we have seen in Section 5.4 that E is not licensed in configurations like (168a) by the strengthening condition. So, the only two logical forms that need to be taken into consideration are (168b) and (168c). Translations for these are given in (169a) and (169b), respectively.

(169) a. $\dagger \boxplus (\forall x.(\mathsf{Student}(x) \to \mathsf{English}(x)) \vee \forall x.(\mathsf{Student}(x) \to \mathsf{French}(x)))$
b. $\dagger(\forall x.(\mathsf{Student}(x) \to \mathsf{English}(x)) \vee \forall x.(\mathsf{Student}(x) \to \mathsf{French}(x)))$

Here we have a familiar situation: the former entails the latter, and is therefore prefered on account of the strongest meaning hypothesis. So (167) is predicted to be interpreted as an alternative question, presupposing that exactly one of the two subjects is taken by every student, and requesting a response that specifies which of the two it is. Exactly the same prediction is made for the explicitly bi-clausal variant of (167), so the two are correctly predicted to exhibit the same semantic behavior, even though syntactically they are treated differently.

Next, let us consider a structurally indeterminate open interrogative. Again we immediately look at a case with a quantifier in subject position; cases with referential subjects are analogous.

(170) Does every second grade student here take English↑ or French↑?

Our syntax admits two possible logical forms in this case, one mono-clausal and one bi-clausal (note that in contrast with the cases discussed above, the E operator cannot be involved here, because that would have induced falling intonation on the final disjunct).

(171) a. [INT [OPEN [C_{INT} every second grade student here takes [English or French]]]]
b. [INT [OPEN [[C_{INT} every... English] or [C_{INT} every... French]]]]

The translations of these logical forms are:

(172) a. $?!\forall x.(\mathsf{Student}(x) \to (\mathsf{English}(x) \vee \mathsf{French}(x)))$
b. $?(!\forall x.(\mathsf{Student}(x) \to \mathsf{English}(x)) \vee !\forall x.(\mathsf{Student}(x) \to \mathsf{French}(x)))$

The latter entails the former and is therefore favored by the strongest meaning hypothesis (the propositions expressed by (172a) and (172b) are like those depicted in Figures 10(b) and 10(d), respectively). Thus, it is correctly predicted that (170) requests a response that establishes for at least one of the two subjects that every student takes it, or otherwise that this does not hold for either of the two. Precisely the same prediction is made for the explicitly bi-clausal variant of (170), which can only have the logical form in (174b). So the fact that the structurally indeterminate list and the explicitly bi-clausal list exhibit the same semantic behavior is again accounted for, despite the fact that our syntax does not force them to have the same structure.

Finally, let us consider a structurally indeterminate open declarative.

(173) Every second grade student here takes English↑ or French↑.

We noted in Section 2.3 that such sentences are highly marked, just like their explicitly bi-clausal counterparts. In Section 5.3 we explained why an explicitly bi-clausal open declarative is so highly marked: the proposition that it expresses is also expressed by the corresponding open interrogative, and the latter form is prefered because it maximizes the chance of being interpreted as intended. A similar explanation can be given for the markedness of (173). Our syntax admits two possible logical forms for this sentence, one mono-clausal and one bi-clausal.

(174) a. [DECL [OPEN [C_{DECL} every second grade student here takes [English or French]]]]
b. [DECL [OPEN [[C_{DECL} every... English] or [C_{DECL} every... French]]]]

The translations of these logical forms are precisely the same as those for the open interrogative in (170). Since open interrogative maximize the chance of being interpreted as intended, and open declaratives do not, this explains the marked status of (173).

5.6 Missing readings

5.6.1 Either

We saw in Section 2.4 that if a disjunctive question is phrased with *either... or* rather than with plain *or*, it can only receive a polar question interpretation, not an alternative or open question interpretation.

(175) Does Igor speak either English or French? *alt *open

This immediately follows from our account, since (175) could only receive an alternative or open question interpretation if it were a bi-clausal list, i.e., if it were an elided version of (176).

(176) *Does Igor speak either English or does he speak French?

But this sentence is ungrammatical, no matter how it is pronounced, presumably for reasons having to do with the distribution of *either*. It does not really matter for our purposes here what the general constraints are that govern the distribution of *either* (see, for instance Larson, 1985; Schwarz, 1999; Hendriks, 2004; Den Dikken, 2006; Kaplan, 2007; Hofmeister, 2010). Under our assumptions, the fact that (176) is ungrammatical immediately leads to the prediction that (175) does not have an alternative or open question interpretation.

It is worth pointing out some particular benefits of the way that this datapoint is accounted for here. First, from the observation that *either* blocks alternative question readings, it may be tempting to hypothesize that it is incompatible with exclusive strengthening. However, we have already seen that this is not the case in general, namely, as exemplified in (177) below, *either* is perfectly compatible with exclusive strengthening in declaratives.

(177) Igor speaks either English↑ or French↓. ⇝ exactly one of the two

Our account indeed predicts that *either* can co-occur with exclusive strenghtening in declaratives, but not in interrogatives. Crucial for this is the fact that the distribution of exclusive strengthening is regulated semantically, by the *strengthening condition*, and not by a syntactic constraint that would prevent it from applying to sub-clausal disjunctions altogether. As a result, we have seen that in declaratives, exclusive strengthening can indeed apply to sub-clausal disjunctions, and in this case it can very well co-occur with *either*. On the other hand, in interrogatives exclusive strengthening cannot apply to sub-clausal disjunctions; it can only be present in bi-clausal structures, and these do not license *either*.

Second, from considering simple closed declaratives with *either*, like (177), it is sometimes concluded (see, e.g. Gamut, 1991) that *either* itself forces an exclusive reading of the disjunction. This is quite different from what we are proposing here. Namely, on our account *either* by itself has no semantic role to play, i.e., *either... or* disjunctions are interpreted just like plain *or* disjunctions. Only, in the presence of *either* certain syntactic parses may become unavailable, which in turn may exclude certain semantic interpretations of the construction that the disjunction is part of, as exemplified in (175).

Evidently, in order to make the right predictions concerning *either... or* disjunctions in interrogatives, *either* should not be taken to force an exclusive reading. But even in declaratives, *either... or* disjunctions can, and sometimes *must* be interpreted inclusively. This is particularly clear if such disjunctions occur in the scope of downward monotonic or non-monotonic operators, as in (178) and (179), respectively.

(178) No second grade student here takes either English or French.

(179) Exactly five second grade students here take either English or French.

Unless *or* itself is pronounced with strong emphasis (see footnote 6) the disjunctions in these sentences have to be interpreted inclusively. For instance, (178) is false if some students turn out to take both English and French, and (179) is equally false if it turns out that there are six students who take both subjects.

Add here:
Anna Szabolcsi's observation that clausal *either* in declaratives is always interpreted exclusively (see Szabolcsi, 2015, p.196). This is accounted for by the strongest meaning hypothesis.

Finally, from the fact that our initial example, (175), does not allow an alternative or open question interpretation, it may also be tempting to conclude that *either* expresses the ! operator, i.e., that it flattens the alternatives generated by the disjunction. Such an analysis would in principle also be compatible with the declarative cases that we considered, (177)-(179). However, this is again different from what we are proposing, and for good reasons. Namely, it has been forcefully argued by Simons (2005a,b); Alonso-Ovalle (2006, 2009); Aloni (2002, 2007); Aloni and Ciardelli (2013); Ciardelli *et al.* (2017, among others) that the alternative-generating potential of disjunction does not only play a crucial role in disjunctive questions, but also in modal constructions, imperatives, and conditionals. Some representative examples are given in (180)-(181) below.

(180) Jane may sing or dance. (Simons, 2005a)

(181) Do your homework or help your father in the kitchen! (Aloni, 2007)

(182) If we had had good weather this summer or the sun had grown cold, we would have had a bumper crop. (Alonso-Ovalle, 2006)

The challenge presented by modal constructions like (180) is to account for the so-called free choice inference that Jane is both permitted to sing and permitted to dance. Similarly, the imperative in (181) grants the addressee a choice between doing their homework and helping their father in the kitchen. Finally, in interpreting the counterfactual conditional in (182), the consequent should not only be evaluated w.r.t. worlds that differ minimally from the actual world and make the antecedent true (as the classical account of counterfactuals due to Stalnaker, 1968; Lewis, 1973, would have it), for this would restrict our attention just to good-wheather worlds and ignore the further removed cold-sun worlds; rather, we need to consider each disjunct in the antecedent in its own right. This can all be achieved in a rather straightforward and transparent way if disjunction is taken to generate alternatives, as it does in our current inquisitive semantics framework and also in the *alternative semantics* framework advanced by Aloni (2002), Kratzer and Shimoyama (2002), Simons (2005a), Alonso-Ovalle (2006), and others.[25]

[25]See Theiler (2014); Ciardelli *et al.* (2016) for discussion of some fundamental architectural differences between

Now, the crucial observation is that *either* does not revoke the free choice inferences in (180) and (181), nor the need to evaluate the consequent of (182) in cold-sun worlds, as witnessed by (183)-(184) below.

(183) Jane may either sing or dance.

(184) Either do your homework or help your father in the kitchen!

(185) If either we had had good weather this summer or the sun had grown cold, we would have had a bumper crop.

Clearly, we would like these cases to be accounted for in exactly the same way as the corresponding examples without *either* in (180)-(182). But for this it is crucial that we do not treat *either* as expressing the ! operator, i.e., as flattening the alternatives generated by the disjunction. Turning back to disjunctive questions, this means that the potential of *either* to block alternative and open question interpretations should not be explained in terms of flattening alternatives either. The fact that our theory provides a different explanation is therefore particularly attractive.

5.6.2 Accentuation

Now let us turn to the observation that, in open and alternative questions, only contrastive elements within the two disjuncts can receive prominent pitch accents. Additional pitch accents lead to ungrammaticality / uninterpretability (cf., Han and Romero, 2004b; Beck and Kim, 2006). The relevant examples from Section 2.4 are repeated below.

(186) *Did Peter only introduce BILL↑ to SUE↑ or to MARY↓? *alternative question

(187) *Did Peter only introduce BILL↑ to SUE↑ or to MARY↑? *open question

Recall that similar pitch accents in polar questions do not lead to ungrammaticality:

(188) Did Peter only introduce BILL↑ to Sue-or-Mary↑? ✓polar question

Our theory accounts for these observations, provided that the relevant pitch accents are taken to signal *focus*, and that ellipsis of focused material is subject to the so-called *focus deletion constraint* (Heim, 1997; Merchant, 2001; Romero, 2000; Han and Romero, 2004a), formulated in (189).

(189) **Focus deletion constraint**
A focused element can only be elided if its entire focus domain is elided with it.

To illustrate the effects of this constraint outside the domain of disjunctive questions, let us consider an example from Han and Romero (2004a, p.198), where the domain of each focused element is indicated with brackets:

(190) Mary only [told John to eat FRUIT in the morning], and
Sue only [told him to eat FRUIT in the morning] as well.

(191) *Mary only [told John to eat FRUIT in the morning], and
Sue only [told him to] as well.

The focus deletion constraint correctly predicts that (191) is ungrammatical, because it involves deletion of a focused element without deletion of its entire focus domain. Han and Romero also provide the following example to show that deleting focused constituents does not lead to ungrammaticality if the entire focus domain is deleted with it:[26]

the two frameworks, and Roelofsen (2015); Ciardelli and Roelofsen (2017) for more specific comparison of how they treat disjunction.

[26] See also Frazier *et al.* (2007) for experimental evidence that there is nothing wrong in principle with eliding focused elements.

(192) Mary told John to only [eat FRUIT] in the morning, and
Sue [told him to] as well.

Now let us return to (186) and (187). On our account (186) can only be interpreted as an alternative question if it is syntactically analyzed as a disjunction of two full interrogative clauses, with the second clause almost entirely elided. That is, in order for (186) to be interpreted as an alternative question it has to be an elided version of (193), where focus domains are again indicated by means of brackets.

(193) Did Peter only [introduce BILL↑ to SUE↑]
or did he only [introduce BILL↓ to MARY↓]? ✓alternative question

But the focus deletion constraint does not allow us to go from (193) to (186) by means of ellipsis, because this would involve eliding a focused element without eliding the entire focus domain.

A similar explanation is available for the fact that (187) cannot be interpreted as an open question. Namely, it could only be interpreted as an open question on our account if it could be analyzed as a disjunction of two full interrogative clauses, i.e., as an elided version of (194).

(194) Did Peter only [introduce BILL↑ to SUE↑]
or did he only [introduce BILL↑ to MARY↑]? ✓open question

Again, the focus deletion constraint blocks this possibility.

Finally, note that our account also predicts that a polar question interpretation is readily available for sentences like (188), since such an interpretation arises precisely if we do *not* analyze the sentence as a disjunction of two interrogative clauses, but rather as a single clause containing a disjunction. As a consequence, the focus deletion constraint does not come into play in this case.

Thus, our syntactic and semantic account of lists, together with the focus deletion constraint, explain the given observations in a straightforward way. The same observations have also been accounted for previously by Han and Romero (2004a) and by Beck and Kim (2006), and it is instructive to compare our account with theirs.[27]

Han and Romero: clausal disjunction plus ellipsis. The account of Han and Romero (2004a) is, at least at first sight, very similar to ours: it is based on the assumption that alternative questions can only be derived from syntactic representations in which disjunction operates at a clausal level. Thus, in order to interpret (186) as an alternative question, it would have to be analyzed as an elided version of (193), and this is impossible because of the focus deletion constraint.

This example, then, is explained just like on our account. However, if we look beyond this particular example, we find some crucial differences between the two proposals. First, on Han and Romero's account, it must be *stipulated* that alternative questions can only be derived from syntactic respresentations in which disjunction operates at a clausal level. This stipulation is implemented by requiring from any disjunction that associates with the question operator Q that it only accepts clausal disjuncts. So, in effect, some disjunctions are assumed to behave differently than others.

On our account, it follows directly from the way in which logical forms are semantically interpretated (more specifically, from the fact that complementizers flatten the alternatives that are generated by any disjunctions within their scope) that alternative questions can only be derived from disjunctions of full interrogative clauses. No specific stipulations are needed. In particular, the disjunction operator itself always behaves the same, whether occurring in an alternative question or in any other construction.

Besides this gain in theoretical parsimony, there is also a difference in empirical coverage. Our proposal and that of Han and Romero both account in much the same way for examples like **??**. But

[27] Han and Romero (2004a) and Beck and Kim (2006) were not concerned with open question interpretations, so our comparison is restricted to alternative question interpretations.

there are slightly more involved examples that fall beyond the scope of Han and Romero's account. Consider the following.

(195) *Did Peter only tell BILL↑ that he invited SUE↑ or MARY↓? *alternative question

On Han and Romero's account, alternative question readings are established if disjunction operates at a clausal level. And there is nothing that prevents us from construing (195) as an elliptical version of (196), where disjunction indeed operates at a clausal level. In particular this would not be in violation of the focus deletion constraint.

(196) *Did Peter only [tell BILL↑ that he invited SUE↑ or that he invited MARY↓]? *altq

Thus, Han and Romero cannot account for the unavailability of an alternative question reading in (195) in terms of the focus deletion constraint. Moreover, the fact that (196) itself does not admit an alternative question reading either, remains unaccounted for as well: in this case there is nothing that forces ellipsis, so the focus deletion constraint does not come into play at all.

On our account, (195) and (196) could only be interpreted as alternative questions if they could be construed as elided versions of (197):

(197) Did Peter only [tell BILL↑ that he invited SUE↑] ✓alternative question
or did he only [tell BILL↓ that he invited MARY↓]?

But (195) and (196) cannot be elided versions of (197), because of the focus deletion constraint. So our assumptions lead to a uniform account of **??**, (195), and (196).

Han and Romero actually discuss an example that is similar to (195) and (196) (see Han and Romero, 2004a, p.210). They acknowledge that their account does not apply in this case. Instead, they suggest that the unavailability of alternative question readings here may be due to *intervention effects* (which we will discuss right below). However, even if an account of cases like (195) and (196) in terms of intervention effects is tenable, this leads us to the undesirable situation in which two types of examples that seem to be manifestations of one and the same phenomenon are accounted for by two distinct mechanisms.

Beck and Kim: intervention effects. Beck and Kim (2006) take a rather different approach: they assume that, in order to derive an alternative question interpretation, disjunction must generate *focus alternatives*, and these alternatives must be converted into ordinary alternatives by the question operator Q. This means that the focus alternatives generated by the disjunction must be passed up all the way to Q, and Beck and Kim assume that this process may be obstructed by certain *intervening operators*. Focus-sensitive operators like *only* are taken to be such intervening operators: they evaluate the focus alternatives generated by their prejacent, and do not pass these alternatives on to be evaluated again later by Q. This, then, explains the uninterpretability of sentences like (186).

What makes this approach particularly interesting is that focus sensitive operators have been argued to behave as intervening operators in *wh*-interrogatives as well (see especially Beck, 2006). For instance, assuming that in *wh*-interrogatives the focus alternatives that Q takes as its input are generated by the *wh*-elements rather than by disjunction, the status of *only* as an intervening operator could explain the contrasts in (198) and (199):

(198) a. Wen hat Luise wo gesehen? (German)
Who has Luise where seen?
'Who did Luise see where?'
b. #Wen hat nur LUISE wo gesehen?
Who has only LUISE where seen?
'Who did only LUISE see where?'

(199) a. Which diplomat did Obama discuss which issues with?
b. #Which diplomat did only OBAMA discuss which issues with?

However, there are at least two potential issues with Beck and Kim's account of the uninterpretability of sentences like (186). The first arises when we consider cases like (200), which has the same focus pattern as (186), but no focus-sensitive operator:

(200) *Did Peter introduce BILL↑ to SUE↑ or to MARY↓? *alternative question

Without additional assumptions, the intervention account does not predict this sentence to be uninterpretable, since there is no focus-sensitive operator intervening between the disjunction and Q. Note that from our perspective (and from Han and Romero's) this example is essentially identical to (186), and is accounted for straightforwardly.

Beck and Kim (2006, p.205) mention this shortcoming of their account, and refer to (Beck, 2006) for more discussion of this issue. Beck (2006, p.31-32) indeed discusses an example in which intervention seems to be caused by a focused element, rather than by a focus-sensitive operator:

(201) ??Wen hat LUISE wo gesehen?
Who has LUISE where seen?
'Who did LUISE see where?'

Beck speculates that the focus alternatives that are generated by the focused element must be evaluated somehow, and that this forces the presence of an implicit focus-sensitive operator, which causes the intervention effect. But this hypothesis seems rather problematic. For one thing, one is left wondering why the focus alternatives could not just be evaluated by the question operator itself, which on Beck's account is crucially seen as a focus sensitive operator. Another question is to what extent the supposed intervention effect is a robust empirical phenomenon. For instance, the Dutch variant of (201) does not exhibit any intervention effect:

(202) Wie heeft LUISE waar gezien? (Dutch)
Who has LUISE where seen?
'Who did LUISE see where?'

Even so, the Dutch variant of (200), given below, is just as uninterpretable as its English and German counterparts.

(203) *Heeft Peter BILL↑ voorgesteld aan SUE↑ of aan MARY↓? (Dutch)
Did Peter BILL↑ introduced to SUE↑ or to MARY↓?
'Did Peter introduce BILL↑ to SUE↑ or to MARY↓?'

More empirical research is needed to straighten out the facts, but it is at best unclear at this point whether the intervention account makes the right predictions in these cases.

A second problem arises when we consider examples like (204), where there is a focus-sensitive operator, but no focused constituents other than the contrastive elements in the two disjuncts.

(204) Did Peter only introduce Bill to SUE↑ or to MARY↓? ✓alternative question

The intervention account wrongly predicts uninterpretability in this case, because the focus-sensitive operator intervenes between the disjunction and Q. One may be tempted to suggest that the interpretation process can be 'saved' here by assuming ellipsis. That is, one could construe (204) as an elliptical version of (205):

(205) Did Peter only introduce Bill to SUE↑ or did he only introduce Bill to MARY↓?

In this construction *only* does not scope over the disjunctive phrase, and hence does not intervene.

However, as soon as ellipsis is brought back into the picture, we also have to reconsider the example that we started out with, (186), repeated here in (206).

(206) *Did Peter only introduce Bɪʟʟ↑ to Sᴜᴇ↑ or to Mᴀʀʏ↓? *alternative question

If intervention effects can be obviated by ellipsis, then we are back to the question why (206) cannot be derived by ellipsis from (207):

(207) Did Peter only introduce Bɪʟʟ↑ to Sᴜᴇ↑ or did he only introduce Bɪʟʟ↓ to Mᴀʀʏ↓?

Beck and Kim (2006, p.203-204) are well aware of this issue, and suggest that something like Han and Romero's focus deletion constraint seems to be needed after all. But then the question arises whether one would really like to stick to the assumption that alternative questions can only be derived in the particular way that Beck and Kim assume. This assumption is needed if we want to explain (some of) the observed restrictions as intervention effects. But we have seen that not all restrictions can be explained as such. On the alternative account proposed here, the focus deletion constraint really does all the relevant work just by itself. This, then, seems to be the most economical way to account for the facts.

To sum up this subsection, the fact that alternative and open question interpretations can only be derived on our account from disjunctions of full interrogative clauses naturally explains why certain constructions *cannot* be interpreted as alternative or open questions. We have considered two types of such constructions. The first involved *either... or* disjunctions; the second involved *focused* constituents beyond the contrastive elements in each disjunct. The case of *either... or* was immediately accounted for. The second required a specific constraint on ellipsis, namely Han and Romero's *focus deletion constraint*, which has been argued for independently, i.e., based on phenomena beyond the realm of disjunctive questions, by Heim (1997), Merchant (2001), and Romero (2000).

5.7 Alleged island effects

Recall from Section 2.4 that it has been proposed by Larson (1985) and Han and Romero (2004b), motivated by examples like (208) below, that alternative questions are subject to island effects, i.e., that they involve movement of a (possibly silent) *whether* from the edge of the disjunctive phrase to spec-CP, and that this movement is sensitive to islands, just like movement of *wh*-elements in *wh*-interrogatives.

(208) Do you believe the claim that Bill resigned or retired? *alternative question

The fact that (208) does not admit an alternative question interpretation can then be seen as a manifestation of the same island constraints on movement that render (209) ungrammatical:

(209) *What do you believe the claim that Bill did?

However, Beck and Kim (2006) argue against this proposal, based on examples like (210).

(210) Do you need a person who speaks Dutch or German? ✓alternative question

Larson and Han and Romero wrongly predict that (210) does not admit an alternative question interpretation, because the corresponding *wh*-construction is ungrammatical:

(211) *What do you need a person who speaks?

Thus, the movement account of (208) is problematic. However, an alternative account of this type of examples has not been given yet, neither by Beck and Kim nor in subsequent work (see Biezma and Rawlins, 2012, for a recent overview of the debate).

Our account suggests a new perspective on this unresolved issue. Namely, whether examples like (208) and (210) admit an alternative question interpretation is, on our account, not primarily governed by constraints on movement, but rather by constraints on *ellipsis*. For instance, (208) can only be interpreted as an alternative question if it can be analyzed as an elliptical variant of (212), and similarly, (210) can only be interpreted as an alternative question if it can be analyzed as an elliptical variant of (213); in both cases, the part that needs to be elided is displayed in gray.

(212) Do you believe the claim that Bill RESIGNED↑ or do you believe the claim that he RETIRED↓?

(213) Do you need a person who speaks DUTCH↑ or do you need a person who speaks GERMAN↓?

There are many different kinds of ellipsis (e.g., sluicing, gapping, stripping, and VP ellipsis), each with its own licensing conditions (see, e.g., Van Craenenbroeck and Merchant, 2013, for an overview). The question that arises, then, is which kind of ellipsis is involved in the formation of alternative questions, and what are the constraints that govern this kind of ellipsis.

Evidently, under our assumptions about the syntax and semantics of alternative questions, examples like (208) and (210) must involve some kind of clausal ellipsis. But even when we restrict ourselves to clausal ellipsis phenomena, various different flavors can be distinguished (see again Van Craenenbroeck and Merchant, 2013). One kind of clausal ellipsis that seems to be of particular interest for our purposes is the one involved in the formation of *fragment answers* (see, e.g., Merchant, 2005; Griffiths and Lipták, 2014). Indeed, the puzzling contrast between Larson's example, (208), and that of Beck and Kim, (210), occurs in the domain of fragment answers as well:

(214) Do you believe the claim that John resigned? *No, retired. *fra

(215) Do you need someone who speaks Dutch? No, German. ✓fra

The parallel between alternative questions and fragment answers extends to other cases as well. For example, both constructions are grammatical if the ellipsis remnant is part of an adverbial phrase or a possessive, as in (216) and (217). On the other hand, both constructions are ungrammatical if the ellipsis remnant is an adjective in a definite noun phrase, as in (218). In each case, we consider both a 'continuous' version of the alternative question (which presumably involves right node raising of the material that appears after the disjunctive phrase, cf., Han and Romero 2004b) and a 'discontinuous' version, which is especially close in form to the corresponding fragment answer example.

(216) *Remnant part of adverbial phrase*

a. Did you freak out when the cat or the dog entered the room? ✓alt
b. Did you freak out when the cat entered the room, or the dog? ✓alt
c. Did you freak out when the cat entered the room? No, the dog. ✓fra

(217) *Possessive remnant*

a. Did you borrow John's or Bill's car? ✓alt
b. Did you borrow John's car, or Bill's? ✓alt
c. Did you borrow John's car? No, Bill's. ✓fra

(218) *Adjectival remnant in definite noun phrase*

a. *Did you use the big or small plates for the pasta? *alt
b. *Did you use the big plates for the pasta, or small? *alt
c. Did you use the big plates for the pasta? *No, small. *fra

These examples suggest that the kind of ellipsis that is involved in the formation of alternative questions is very similar to the kind of ellipsis that is involved in the formation of fragment answers. Especially for the case of 'discontinuous' alternative questions, this seems to be a very natural hypothesis. In the case of 'continuous' alternative questions involving right node raising, we may well find that the parallelism with fragment answers breaks down in certain configurations, precisely because of the interaction between ellipsis and right node raising. Indeed, it is possible to find such configurations, see (219)-(221) below. Interestingly, the discontinuous version of the alternative question, which does not require right node raising, does pattern with the corresponding fragment answer example.

(219) *Adjectival remnant in bare plural noun phrase*

a.	Did you use big or small plates for the pasta?	✓alt
b.	*Did you use big plates for the pasta, or small?	*alt
c.	Did you use big plates for the pasta? *No, small.	*fra

(220) *Nominal remnant in possessive determiner phrase*

a.	Did you see John's brother or sister at the party?	✓alt
b.	*Did you see John's brother at the party, or sister?	*alt
c.	Did you see John's brother at the party? *No, sister.	*fra

(221) *Nominal remnant in nominalized verbal subject*

a.	Would calling John or Mary be the best thing to do in this situation?	✓alt
b.	*Would calling John be the best thing to do in this situation, or Mary?	*alt
c.	Would calling John be the best thing to do in this situation? *No, Mary.	*fra

We will leave open what the precise nature is of the ellipsis process that seems to be involved in the formation of alternative questions and fragment answers, and how the subtle contrasts between alternative questions with and without right node raising are to be explained. However, we hope that the new empirical observations and the new theoretical perspective that we have offered here will prove fruitful in resolving the debate initiated by Larson, Han and Romero, and Beck and Kim. In any case, it seems that the puzzle that these authors identified does not pertain exclusively to the specific realm of alternative questions but rather instantiates a more general phenomenon.

ADD

A remark about open questions, which on our account are also taken to involve the same kind of ellipsis. Interestingly, in certain cases where a discontinuous alternative questions seems bad, an open question seems better. For instance:

(222)	a.	*Would calling JOHN↑ be appropriate in this situation, or MARY↓?	*alt
	b.	✓Would calling JOHN↑ be appropriate in this situation, or MARY↑?	✓open

A similar contrast seems to exist between different types of fragment answers:

(223)	a.	Would calling JOHN↑ be appropriate in this situation↑? *No, MARY↓.	*fra
	b.	Would calling JOHN↑ be appropriate in this situation↑? ✓Yes, or MARY↓.	✓fra

5.8 Embedded lists

Declarative and interrogative lists can be embedded, although, as observed in Section 2.6, the correlation between prosody and interpretation is not as clearcut in this case, because the realization of the prosodic features of an embedded list may be partly or entirely 'overruled' by the realization of prosodic features associated with the matrix list. A detailed account of the prosody and interpretation of embedded lists is left for another occasion. However, we do want to account for one particularly striking observation that was made in Section 2.6, namely that *declarative* embedded lists are never interpreted as *open* lists. For instance, even though (224) below has a final rise, it cannot be interpreted as conveying that Maria has enough information to resolve the issue whether Igor speaks English or not, which is the interpretation that would result from construing the declarative complement as an open list.

(224) Maria knows that Igor speaks English↑.

Our account provides an explanation for this observation. First, we have seen that an open declarative list is always *marked* relative to the corresponding open interrogative, which expresses the same meaning and maximizes the chance of being interpreted as intended (see the discussion on page 43). Second, in embedded contexts, open declaratives are even more marked relative to open interrogatives, because the realization of OPEN by means of a final rise is likely to be blurred by prosodic features of the matrix list. So in embedded contexts there is even more pressure to express the intended content using an interrogative. Finally, while at the matrix level the use of a marked form may serve to signal special discourse effects—in particular, open declaratives tend to signal a bias on the speaker's part for one of the alternatives in the proposition expressed—the use of a marked form in an embedded context cannot serve such a purpose. Thus, it is not only disadvantageous, but also pointless to use a marked form in an embedded context. These considerations explain why embedded declarative lists are never construed as open lists.

5.9 Redundancy

Recall from Section 2.7 that disjunctions where one disjunct entails another, such as (225), are generally infelicitous (no matter the intonation pattern):

(225) *John is American or Californian.

This phenomenon was first noted by Hurford (1974) and has been referred to in the subsequent literature as *Hurford's constraint*. Simons (2001), Katzir and Singh (2013) and Meyer (2014) have offered a natural explanation of the phenomenon in terms of *redundancy*: a Hurford disjunction is equivalent with one of the individual disjuncts, rendering the other disjunct, and the disjunction operation as such, redundant.

Also recall from Section 2.7, however, that there are apparent counterexamples to Hurford's constraint, such as (226).

(226) ✓Mary will bring WINE↑, or JUICE↑, or BOTH↓.

Chierchia *et al.* (2009, 2012), Katzir and Singh (2013) and Meyer (2014) suggest that such apparent counterexamples may be explained by the assumption that the reconstruction of the logical form of a given sentence may involve the insertion of *exhaustive strengthening* operators, which when applied to a constituent X, negate every focus/scalar alternative for X that is stronger than X itself. For instance, when applied to 'Mary will bring JUICE', with focus on 'JUICE', it yields 'Mary will *only* bring JUICE'. Assuming that such an operator may indeed be inserted in the interpretation process, the contrast between (225) and (226) can be given a principled explanation: Hurford's constraint holds without exceptions, due to a general ban on redundancy, but in some cases the constraint can be obviated by exhaustive strengthening of the weaker disjunct, in such a way that it is no longer redundant.

While this explanation is certainly attractive, the empirical picture is not yet complete. Namely, while Hurford's and Gazdar's observations all involved disjunctions in *declarative* sentences, essentially the same pattern is found in disjunctive *questions* as well (Ciardelli and Roelofsen, 2017). For instance, as noted in Section 2.7, the alternative question in (227) below is just as infelicitous as Hurford's declarative (225), and (228) is as felicitous as its declarative counterpart (226).

(227) *Is John AMERICAN↑, or CALIFORNIAN↓?

(228) ✓Will Mary bring WINE↑, or JUICE↑, or BOTH↓?

The literature cited above on Hurford disjunctions in declarative sentences generally assumes a classical, truth-conditional treatment of disjunction, which is clearly not suitable to capture its role in alternative questions. Therefore, the proposed 'redundancy plus exhaustification account' of Hurford disjunctions does not directly cover cases like (227) and (228). However, Ciardelli and Roelofsen (2017) show that an *inquisitive* treatment of disjunction, which we have adopted in the present paper, makes it possible for the account to deal with disjunctive declaratives and interrogatives in a uniform way.

To see this, first consider the declarative in (225). Suppose that the logical form of this sentence consists of two declarative clauses joined by disjunction (essentially the same analysis would apply to the case where the logical form of the sentence consists of a single declarative clause containing a nominal disjunction):

(229) [DECL [CLOSED [[C_{DECL} John is American] or [C_{DECL} John is Californian]]]]

The first clausal disjunct expresses the proposition that John is American, which in inquisitive semantics is the set of all information states that consist of worlds where John is American. Similarly, the second disjunct expresses the proposition that John is Californian, which is the set of all information states that consist of worlds where John is Californian. Clearly, if all worlds in a given information state are ones where John is Californian, all worlds in that information state are also ones where John is American. Thus, the proposition expressed by the second disjunct is contained in the proposition expressed by the first disjunct, and if we take their union we end up with exactly the same proposition that was already expressed by the first disjunct. This means that the second disjunct is redundant, and the sentence is predicted to be infelicitous.

As before, redundancy is avoided in cases like (226) by applying exhaustive strengthening to the disjuncts before applying the disjunction operator. The exhaustive strengthening operator can be defined in inquisitive semantics essentially as it is defined in the classical setting: roughly speaking, when applied to a constituent X it yiels the conjunction of X and the negations of all focus/scalar alternatives of X that are stronger than X itself (several ways to make this more precise have been discussed in the literature; each of them can be straightforwardly adapted to the inquisitive setting).

Now consider the interrogative in (227), which on our account is a list of two interrogative clauses:

(230) [INT [CLOSED [E [[C_{INT} is John American] or [C_{INT} is he Californian]]]]

This case can now be treated exactly as its declarative counterpart. Namely, the first disjunct expresses the proposition that John is American, i.e., the set of all information states that consist of worlds where John is American, and the second disjunct expresses the proposition that John is Californian, i.e., the set of all information states that consist of worlds where John is Californian. The second is contained in the first, which means that the disjunction as a whole is equivalent with just the first disjunct. Thus, the second disjunct is redundant and the sentence is therefore predicted to be infelicitous.

In a case like (228), redundancy can be obviated by exhaustive strengthening, again exactly as in its declarative counterpart, (226). Thus, indeed, declaratives and interrogatives are dealt with in a uniform way.

This result may seem almost trivial, but in fact, as discussed in detail in Ciardelli and Roelofsen (2017), in could *not* have been achieved if, instead of inquisitive semantics, we had couched our treatment of disjunctive declaratives and interrogatives in the more traditional *alternative semantics* framework (e.g., Hamblin, 1973; Karttunen, 1977; Alonso-Ovalle, 2006; Biezma and Rawlins, 2012). And, interestingly, this fact is directly connected with one of the fundamental conceptual differences between inquisitive semantics and alternative semantics.

In a nutshell, while both in inquisitive semantics and in Hamblin/Karttunen-type semantics, the meaning of a sentence is a set of sets of possible worlds, i.e., a set of classical propositions, a central feature of inquisitive semantics is that this set is *downward closed*, i.e., if the meaning of a sentence contains a certain set of worlds, then it also contains every subset thereof. This is because the elements of the meaning of a sentence are thought of in inquisitive semantics as information states where the proposal expressed by that sentence is *settled*, with the assumption that if a given proposal is settled in a certain information state then it remains settled in any more informed state.

On the other hand, in alternative semantics the meaning of a sentence does not have to be downward closed (and in practice it never is, except trivially when the sentence is contradictory), because its elements are not thought of as information states where the proposal expressed by the sentence is settled, but rather as embodying the most basic answers to the sentence in question.

As a consequence of this basic difference, the two frameworks yield different predictions when it comes to redundancy in Hurford disjunctions. To see this, consider the interrogative in (227). In alternative semantics, the meaning of the first disjunct is a singleton set containing the classical proposition that John is American, and the meaning of the second disjunct is a singleton set containing the classical proposition that John is Californian. Clearly, neither of these singleton sets is contained in the other. Moreover, taking their union yields a new set, containing both the classical proposition that John is American and the classical proposition that John is Californian. So the disjunction as a whole is not equivalent with either of the individual disjuncts, which means that redundancy is not predicted.

Returning now to our treatment of (227) in inquisitive semantics, we see that downward closure really plays a crucial role. It is because of this feature that the disjunction as a whole is predicted to be equivalent with the first disjunct alone, which means that the second disjunct is predicted to be redundant, as desired.

5.10 Polarity particle responses

Finally, recall from Section 2.8 that there is interesting variation in the distribution and interpretation of *polarity particles* liek *yes* and *no* in responses to the various types of lists that we have considered. In particular, we illustrated in Section 2.8 that polar questions, whether containing a disjunction or not, do license polarity particle responses, just like declarative sentences, while alternative questions generally do not license such responses. Finally, we showed that open disjunctive questions exhibit a mixed pattern: they do not license 'bare' *yes* responses, but bare *no* responses are fine and *yes* is also acceptable if accompanied by a phrase that explicitly confirms one of the disjuncts. The relevant examples are repeated below (see Section 2.8 for explicit contexts in which these questions may be asked).

(231) Does Igor speak English-or-French↑?

a. ✓ Yes. / ✓ Yes, he speaks English. / ✓ Yes, he speaks French.
b. ✓ No. / ✓ No, he only speaks Russian.

(232) Does Igor speak English↑, or French↓?

a. #Yes. / #Yes, he speaks English. / #Yes, he speaks French.
b. #No. / #No, he doesn't speak either. / #No, he speaks both.

(233) Does Igor speak English↑, or French↑?

a. #Yes. / ✓ Yes, he speaks English. / ✓ Yes, he speaks French.
b. ✓ No. / ✓ No, he only speaks Russian.

This three-way contrast, as well as a range of other interesting empirical facts concerning polarity particle responses are accounted for in Roelofsen and Farkas (2015), and core of the semantics developed there is a simplified version of the account of declarative and interrogative lists presented here.[28] It is simplified in that it purposely leaves exclusive strengthening and presuppositional

[28]There are several other recent accounts of polarity particle responses as well (e.g., Kramer and Rawlins, 2011; Holmberg, 2013; Krifka, 2013). However, neither of these deals with polarity particle responses to disjunctive questions

aspects of meaning out of consideration, which do not seem directly relevant for polarity particle responses. On the other hand, it also adds a level of sophistication to the semantics presented here, in that it does not only capture the informative and inquisitive content of the various kinds of lists, but also the propositional discourse referents that each of them makes available for subsequent anaphoric reference.

For instance, their semantics compositionally derives that the polar question in (231) and the open question in (233) both introduce a single propositional discourse referent, namely the set of all worlds where Igor speaks at least one of the two listed languages, while the alternative question in (232) introduces two propositional discourse referents, the set of worlds where Igor speaks English and the set of worlds where he speaks French.

Polarity particles, then, are taken to presuppose that the context of utterance furnishes a unique propositional discourse referent that may serve as their antecedent. If this presupposition is satisfied, *yes* confirms the antecedent, while *no* negates it.[29] This accounts for the three-way contrast in (231)-(233). First, in response to a polar question, both *yes* and *no* are licensed because there is a unique suitable antecedent, and both particles fully resolve the issue that the question expresses, by either confirming or denying their antecedent. Second, in response to an alternative question, neither *yes* nor *no* is licensed because the context does not furnish a unique suitable antecedent. Finally, in response to an open question, both *yes* and *no* are in principle licensed, because the context furnishes a unique suitable antecedent. However, only *no* satisfactorily resolves the issue that the question expresses; *yes* does not achieve this: in our specific example, it confirms that Igor speaks at least one of the two listed languages, but in order to resolve the issues that the question expresses it needs to be established which of the two languages he speaks. This explains the unacceptability of a bare *yes* response, and also why a *yes* response does become acceptable if it is accompanied by an explicit confirmation of one of the two disjuncts.

This concludes the presentation of our account of declarative and interrogative lists and its empirical coverage. In the next section, we further clarify certain aspects of our proposal, in particular our account of exclusive strengthening, through comparison with several related ideas in the literature.

6 More on exclusive strengthening

In this section we take a closer look at our treatment of exclusive strengthening—both the operation itself and the *strengthening condition* which restricts its distribution—in comparison with various closely related notions that have been proposed elsewhere. Section 6.1 compares our notion of exclusivity with two notions of *exhaustivity* that have played a role in recent work on alternative questions (Rawlins, 2008; Pruitt, 2008; Biezma, 2009; Biezma and Rawlins, 2012). Section 6.2 considers various alternative ways in which the exclusive strengthening operator could have been implemented. One concrete alternative is provided by Rawlins (2008); a second alternative is suggested by the work of Fox (2007) and Alonso-Ovalle (2008). We will highlight some ways in which our implementation differs from these two potential alternatives, and we will also show that it actually yields precisely the same results that would be obtained by adapting the exclusive strengthening operator of Menéndez-Benito (2005) to inquisitive semantics, though arguably in a slightly more direct way (to do) . Section 6.3 considers Gricean pragmatics as an explanation for the exclusive interpretation of disjunction. It shows that some exclusivity effects can be explained pragmatically, but others really seem to require a semantic exclusive strengthening operator. Finally, Section 6.4 compares our operation of exclusive strengthening to the operation of *scalar strengthening* that has played a central role in recent work of Chierchia, Fox, and Spector (2012). Disjunction is viewed as a

and assertions in much detail. Further differences between the various accounts are discussed in Roelofsen and Farkas (2015).

[29] In fact, a refinement of this basic idea is needed to account for cases involving negation. This is worked out in detail in Roelofsen and Farkas (2015), but will be left out of consideration here.

scalar item, and when scalar strengthening is applied to disjunction it yields an exclusive interpretation, just like our operation of exclusive strengthening. One may wonder, then, whether the role that exclusive strengthening plays in our theory could perhaps just as well be played by scalar strengthening instead. However, we will show that there are some important differences between the two operations, and that exclusive strengthening cannot be replaced in our account by scalar strengthening.

We should emphasize at the outset that our main purpose in this section is not to assess related proposals in full detail, let alone to provide a comprehensive overview of the literature on the exclusive interpretation of disjunction in declaratives and interrogatives. Rather, our main objective here is just to clarify certain aspects of our own account by contrasting it with some related ideas.

6.1 Exclusivity and exhaustivity

We start by comparing our notion of exclusivity to two different notions of exhaustivity that have played a role in recent work on alternative questions.

6.1.1 Context set exhaustivity

A first notion of exhaustivity pertaining to alternative questions can be found in the work of Rawlins (2008, pp.122–127). Rawlins, who formulates his account of alternative questions within the framework of alternative semantics (Hamblin, 1973; Kratzer and Shimoyama, 2002; Alonso-Ovalle, 2006, a.o.), assumes that an interrogative clause $[Q\,\varphi]$ generally presupposes that the alternatives in $[\![\varphi]\!]$ *exhaust the context set*, where the context set is the set of all possible worlds that are compatible with the speech participants' mutual public commitments (Stalnaker, 1978).[30] That is, an interrogative clause $[Q\,\varphi]$ generally presupposes that every world in the context set is included in at least one of the alternatives in $[\![\varphi]\!]$. We will refer to this notion of exhaustivity as *context set exhaustivity*.

Rawlins (2008, pp.127–128) also assumes that an interrogative clause generally involves what he calls a *mutual exclusivity* presupposition. That is, an interrogative clause $[Q\,\varphi]$ generally presupposes that, relative to the context set, the alternatives in $[\![\varphi]\!]$ do not overlap. In other words, $[Q\,\varphi]$ presupposes that every world in the context set is included in at most one of the alternatives in $[\![\varphi]\!]$.

Thus, Rawlins thinks of exhaustivity and mutual exclusivity as complementary notions: one requires that every world in the context set be contained in *at least one* alternative in $[\![\varphi]\!]$, and the other requires that every world in the context set be contained in *at most one* alternative in $[\![\varphi]\!]$. Both requirements play a role in Rawlins' treatment of the question operator, given in (234) (Rawlins, 2008, p.128, notation and terminology slightly adapted).

(234) $$[\![Q\,\varphi]\!]^c = \begin{cases} [\![\varphi]\!]^c & \text{if every world in the context set } c \text{ is} \\ & \text{contained in exactly one alternative in } [\![\varphi]\!] \\ \text{undefined} & \text{otherwise} \end{cases}$$

Our notion of exclusivity embraces *both* exhaustivity and mutual exclusivity in Rawlins' sense. Namely, we characterized the exclusive component of an alternative question as the presupposition that *exactly one* of the disjuncts holds. This presupposition has an *at least one* component and an *at most one* component. The former could be seen as an *exhaustivity* component and the latter as a *mutual exclusivity* component in Rawlins' sense. We did not see a need to separate these two components, and used the term *exclusivity* in a strong sense (*exactly one* rather than *at most one*) to cover both. But in principle, separating the two components as Rawlins does is compatible with everything else we have said.

Thus, at a broad conceptual level our take on the exclusive component of alternative questions is very similar to that of Rawlins. However, at a more detailed implementational level, there is

[30] We used the term common ground for this earlier.

an important difference. Namely, Rawlins assumes that the exclusive/exhaustive strengthening operator is, as it were, 'built in' to the question operator. On our account, the exclusive strengthening operator is an independent operator—an intonational morpheme—which is not tied to Q, but rather to disjunction. This allows us to account straightforwardly for alternative questions which consist of two full interrogative clauses separated by disjunction, and it opens the way for a unified account of intonationally triggered exclusivity effects in interrogatives and declaratives, both at the clausal and at the sub-clausal level. These consideration have been important factors in developing our account of exclusive strengthening.

It must be noted here that the work of Biezma and Rawlins (2012), which further develops that of Rawlins (2008), does assume a separate exhaustivity operator. However, given the way that this operator is defined (p.388, def.47) Biezma and Rawlins effectively still assume that the operator only applies to interrogative clauses; in fact, they even assume that the operator only applies to *disjunctive* interrogative clauses. Under this assumption, the system clearly does not account for alternative questions that consist of two full interrogative clauses separated by disjunction, and it does not allow for a unified account of prosodically marked exclusivity effects in interrogatives and declaratives, just like Rawlins' (2008) original account.

In a footnote (p.388, fn.24), Biezma and Rawlins remark that "while this operator [...] can be construed as a specialized operator for alternative questions, it is easily generalized to all propositional lists." However, if the given operator is indeed taken to apply to lists in general, in particular to declaratives, then the theory makes the problematic prediction that a declarative sentence with a final fall always *presupposes* that exactly one of its disjuncts holds (or that the sentence as a whole holds in case it does not contain any disjunction). This problem does not arise in our setup, because the exclusive strengthening operator is not taken to be inherently presuppositional.

The general conclusion that emerges from this comparison is that any theory which aims to account for alternative questions that consist of two or more full interrogative clauses separated by disjunction, and/or to establish a unified account of prosodically marked exclusivity effects in interrogatives and declaratives should (a) assume that the exclusive strengthening operator applies to disjunctive constituents, rather than to interrogative clauses, and (b) not treat the exclusive strengthening operator as being inherently presuppositional, but rather let the presuppositional component of alternative questions be contributed by interrogativity.

6.1.2 Answer exhaustivity

Now let us turn to a second notion of exhaustivity that has been taken to play a role in the interpretation of alternative questions. This notion originates in work on the interpretation of answers to (possibly implicit) questions under discussion (Groenendijk and Stokhof, 1984; van Rooij and Schulz, 2004; Spector, 2007; Zeevat, 2007, a.o.). Consider the following example:

(235) a. Question: Which European languages does Igor speak?
b. Answer: He speaks FRENCH↓.
c. Exhaustive interpretation: He speaks French, and *no other European languages*.

The notion of exhaustivity at play here is very different from the notion of context set exhaustivity discussed above. The answer in (235b) certainly does not presuppose that every world in the context set is one in which Igor speaks French. Rather, it claims that French is the only European language that Igor speaks. We will refer to this second notion of exhaustivity as *answer exhaustivity*.

The exhaustive interpretation in (235c) is often assumed to result from pragmatic reasoning (if the responder had known that Igor spoke another European language as well, it would have been uncooperative for her not to say so; assuming, then, that the responder is fully cooperative and has complete knowledge as to which European languages Igor speaks, it follows from the given answer that Igor does not speak any European languages besides French). However, Zimmermann (2000) and others have observed that an exhaustive interpretation does *not* arise if the answer is pronounced with a final *rise* rather than a *fall*.

(236) a. Question: Which European languages does Igor speak?
b. Answer: He speaks FRENCH↑. $\rightsquigarrow$ no exhaustive interpretation

Given this observation, Zimmermann (2000, p.261) proposes to view answer exhaustivity as a *semantic* operation, contributed by the final fall.[31] Zimmermann generally thinks of answers to questions as *lists* and assumes that answers with a final fall involve a *closure operator* Γ_P which intuitively 'closes off the list' that is specified by the answer, signaling that nothing but the given list items satisfies the predicate P that the question inquired after.

Pruitt (2008) and Biezma (2009) suggest that this analysis may not only be applicable to declarative answers with a final fall, but also to *questions* with a final fall, in particular alternative questions. Indeed, it can be argued that alternative questions typically convey that, among a set of contextually given alternatives, only one of those that are explicitly listed is supposed to hold. To use an example from Biezma (2009), someone who utters the alternative question in (237) below presupposes that the addressee is not making anything other than pasta or fish.

(237) Are you making PASTA↑ or FISH↓?

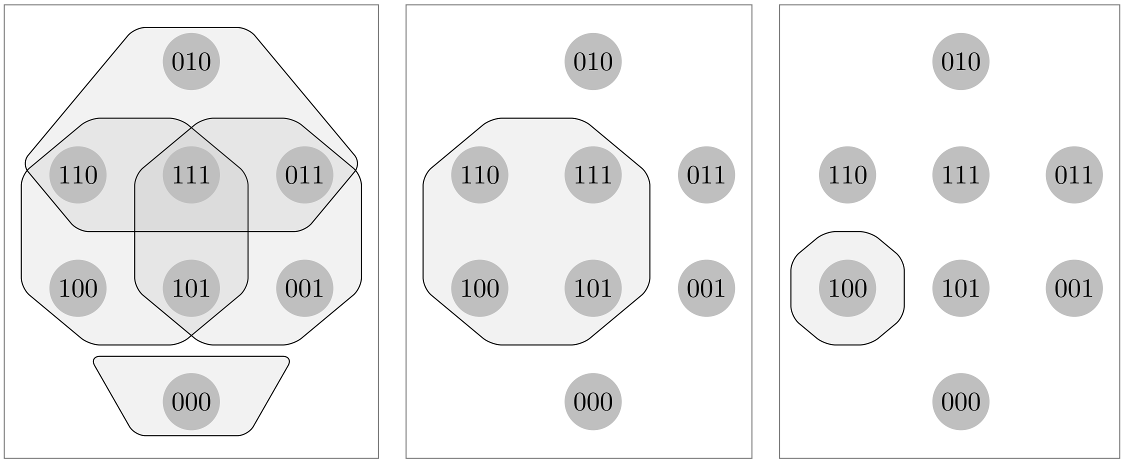
However, generalizing Zimmermann's account of the final fall in terms of exhaustivity in such a way that it applies both to declarative answers and to alternative questions in a uniform way is not a trivial affair. Biezma (2009) offers a concrete proposal, but we think that this is problematic in several ways. We will briefly review the main difficulties, and show how they may be overcome within our framework. Some problems will remain, however, and we will eventually be led to the conclusion that answer exhaustivity is best dealt with as a pragmatic phenomenon after all.

Let us first briefly review Biezma's proposal, and the main problems it faces. Just like Zimmermann, Biezma associates the final fall with a closure operator Γ. However, there are two crucial differences. First, Biezma assumes that the operator does not strengthen the at-issue informative content of the sentence, but rather contributes a presupposition. Clearly, a presuppositional treatment of the closure operator makes incorrect predictions for examples like (235), which motivated the very notion of answer exhaustivity and in particular Zimmermann's treatment of the final fall. Thus, Biezma's proposal really diverges from Zimmermann's in a rather essential way. It does not yield a treatment of the final fall that applies uniformly both to answers and to alternative questions.

Another important difference between Zimmermann's and Biezma's closure operator is that the latter no longer makes reference to a contextually retrievable predicate P (note that Zimmermann denoted the closure operator as Γ_P, while Biezma simply denotes it as Γ, disregarding the P parameter). This makes it difficult, if not impossible, to actually define the operation in a suitable way. Biezma proposes that Γ, when applied to a clause φ, yields exactly the same set of alternatives as φ itself, as long as these alternatives are the only ones that are "epistemically available" in the given context (Biezma, 2009, p.9). Otherwise, $[\![\Gamma\, \varphi]\!]$ is undefined. This characterization is problematic in two ways. First, it remains unclear what it means for an alternative to be or not to be "epistemically available" in a given context. Second, it is unclear which set of alternatives is supposed to constitute the domain that *only* ranges over, i.e., which alternatives are required *not* to be epistemically available in the given context.

How can these problems be overcome? Let us start with those concerning the proper characterization of Γ. These issues are not very serious in fact. It is sufficient to recognize, as Zimmermann

[31] Groenendijk and Stokhof (1984) also treated answer exhaustivity as a semantic phenomenon, for different reasons. However, Westera (2013a,b) shows that neither Groenendijk and Stokhof's considerations nor the observation in (236) really *forces* a semantic treatment of answer exhaustivity. He maintains that answer exhaustivity is a pragmatic phenomenon, and that the final rise in answers like (236b) does not have a semantic effect, but rather signals that the speaker is not certain as to whether her utterance complies with all the maxims that characterize cooperative behavior in the given type of conversation. As a result, exhaustivity does not arise as a conversational implicature in such cases. We will return to this proposal below.



(a) $?\exists x.Px$ (b) Pa (c) $\mathsf{exh}(Pa, ?\exists x.Px)$

Figure 11: Exhaustifying Pa w.r.t. $?\exists x.Px$. We assume that there are just three individuals in the domain, a, b, and c. In world 111 all individuals have the property P, in 110 only a and b have the property P, etcetera.

and Groenendijk and Stokhof and many others did, that exhaustification is an operation that takes *two* inputs rather than just one. The first is an expression whose interpretation is strengthened, and the second is a contextual parameter in terms of which this strengthening procedure is defined. This contextual parameter can be a predicate P, as on Zimmermann's account and also in Groenendijk and Stokhof (1984), or a question under discussion Q, as for instance in Balogh (2009). In our framework it is most straightforward to work with questions under discussion, which can simply be modeled as inquisitive propositions (although it would only be slightly more involved to work with predicates, as Zimmermann and Groenendijk and Stokhof did). For any two propositions A and Q, we define the exhaustification of A w.r.t. Q as follows:

$$\mathsf{exh}(A, Q) := \{\alpha \in A \mid \text{there is no } \beta \in A \text{ such that } \beta \neq \emptyset \text{ and } \textsc{alt}_\beta(Q) \subset \textsc{alt}_\alpha(Q)\}$$

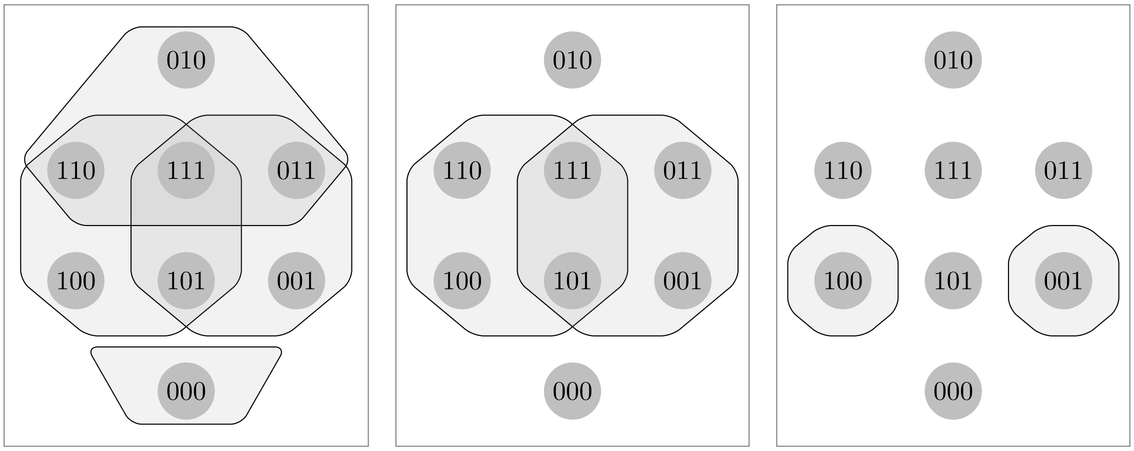
where $\textsc{alt}_\beta(Q) := \{\gamma \in \textsc{alt}(Q) \mid \beta \cap \gamma \neq \emptyset\}$, and similarly for $\textsc{alt}_\alpha(Q)$. At a conceptual level, this notion of exhaustification is very similar to that of Groenendijk and Stokhof (1984) and van Rooij and Schulz (2004). In a slogan, exhaustification is taken to amount to *minimization.* Exhaustifying A w.r.t. Q amounts to selecting all and only those information states $\alpha \in A$ that are compatible with a minimal set of alternatives in $\textsc{alt}(Q)$, i.e., which are such that there is no consistent state $\beta \in A$ that is compatible with strictly less alternatives in $\textsc{alt}(Q)$.[32]

Given this characterization of exh as a semantic operation, we can also add it as a two-place connective to our logical language. When applied to φ and ψ it exhaustifies $[\varphi]$ relative to $[\psi]$, while leaving $\mathsf{presup}(\varphi)$ untouched:

$$[\![\mathsf{exh}(\varphi, \psi)]\!] := \langle \mathsf{presup}(\varphi), \mathsf{exh}([\varphi], [\psi])\rangle$$

For instance, Figure 11 depicts the exhaustification of 'Amy went to the party', Pa, w.r.t. 'who went to the party?', $?\exists x.Px$ (in InqB, the proposition expressed by $?\exists x.Px$ contains one alternative for every individual in the domain, namely, the set of all worlds where that individual went to the

[32]Note that $\mathsf{exh}(A, Q)$ is always downward closed, and that it always contains the inconsistent information state $\emptyset$ because $\textsc{alt}_\emptyset(Q)$ is always empty. Thus, $\mathsf{exh}(A, Q)$ is guaranteed to constitute a proper proposition in the sense of inquisitive semantics.



(a) $?\exists x.Px$ (b) $Pa \vee Pb$ (c) $\mathsf{exh}(Pa \vee Pb, ?\exists x.Px)$

Figure 12: Exhaustifying $Pa \vee Pb$ w.r.t. $?\exists x.Px$.

party, plus one alternative consisting of all worlds where nobody went to the party). This process yields a proposition that contains a single alternative, the set of all worlds where Amy went to the party and nobody else did. That is:

$$\mathsf{exh}(Pb, \exists x.Px) \;\equiv\; \forall x.(Px \leftrightarrow x = b)$$

Similarly, as depicted in Figure 12, exhaustifying $Pa \vee Pb$ w.r.t. $?\exists x.Px$ yields a proposition containing two alternatives, one consisting of all worlds where only a went to the party, and one consisting of all worlds where only b went.

$$\mathsf{exh}(Pa \vee Pb, \exists x.Px) \;\equiv\; \forall x.((Px \leftrightarrow x = a) \vee \forall x.(Px \leftrightarrow x = b))$$

Thus, the exhaustivity operator applies both to purely informative expressions like Pa and to inquisitive ones like $Pa \vee Pb$. As such it can be seen as a generalization of Zimmermann's closure operator, one that is needed if we want to deal uniformly with exhaustification in declaratives and interrogatives. This resolves one of the main problems that we identified for Biezma's account.

The other problem was that the exhaustive component of a declarative answer seems to be part of the at-issue information that the answer conveys, while in the case of an alternative question, it rather seems to have the status of a presupposition. Indeed, Zimmermann, who is concerned with declarative answers, defines exhaustification in such a way that it affects the at-issue content of the answer, while Biezma, who focuses on alternative questions, treats it in such a way that it generates a presupposition. How can this tension be resolved? How can one and the same operator contribute at-issue information in one case and a presupposition in the other?

The architecture of our account actually facilitates a straightforward solution to this puzzle. Recall that both Zimmermann and Biezma associate exhaustification with *closed* lists. On our account, then, it would be most natural to think of it as the semantic contribution of the list classifier CLOSED. Recall that we characterized CLOSED earlier as an operator that merely authorizes DECL or INT, whichever is present, to seal off the body of the list (in contrast to OPEN, which applies the ? operator and does not let DECL/INT seal off the list). That is, we defined CLOSED as an operator that takes as its input a proposition B, provided by the body of the list, and a propositional modifier M, provided by DECL/INT, and yields $M(B)$ as its output.

(238) CLOSED $\rightsquigarrow$ $\lambda B.\lambda M.M(B)$

Now, it would be natural to give CLOSED a somewhat more active role. In particular, in the spirit of Zimmermann, Pruitt, and Biezma, we may assume that it *exhaustifies* B relative to a contextually given proposition Q before feeding it to M.

(239) CLOSED $\rightsquigarrow$ $\lambda B.\lambda M.M(\mathsf{exh}(B, Q))$

This indeed has precisely the desired effect, both in declarative answers and in alternative questions. To see this, first consider the declarative in (240), as an answer to the question who went to the party.

(240) AMY went to the party↓.

On our account, this sentence has the following logical form:

(241) [DECL [CLOSED [C_{DECL} Amy went to the party]]]

Under our adapted assumptions about the role of CLOSED, this logical form is translated as:

(242) $!\,\mathsf{exh}(Pa, ?\exists x.Px)$

The proposition expressed by this formula is the one depicted in Figure 11(c), and its presupposition is trivial. Thus, indeed, in this case exhaustification strengthens the at-issue informative content of the sentence.

Now consider the alternative question in (243).

(243) Did AMY go to the party↑, or did BILL go↓?

This sentence has the following logical form (leaving the E operator out of consideration for now; we will return to this momentarily):

(244) [INT [CLOSED [[C_{INT} did Amy go to the party] or [C_{INT} did Bill go]]]]

Under our adapted assumptions about CLOSED, and assuming that exhaustification still takes place w.r.t. the question 'who went to the party', this logical form is translated as:

(245) $\dagger\,\mathsf{exh}(Pa \vee Pb, ?\exists x.Px)$

The proposition expressed by this formula, depicted in Figure 12(c), consists of two alternatives, the set of all worlds where only Amy went and the set of all worlds where only Bill went. Moreover, because the † operator still applies after exh, the sentence *presupposes* that the actual world is contained in one of these alternatives, i.e., that either only Amy or only Bill went. Thus, indeed, in this case exhaustification affects the presupposition of the sentence. What is crucial for this solution to work is that CLOSED is clearly separated from DECL and INT, and that the body of the list is exhaustified *before* DECL or INT are called upon to seal the list off.

It seems, then, that we have achieved what Pruitt and Biezma had in mind: a single exhaustification operator that applies uniformly both to declarative answers and to alternative questions, strengthening the at-issue information in the first case and contributing a presupposition in the second. In fact, we have achieved something else as well, namely, the exhaustification operator as we have defined it does not only take care of exhaustification in the strictest sense of the term, but also, in one fell swoop, of *exclusive* strengthening. This is witnessed by the fact that the two alternatives in $[\mathsf{exh}(Pa \vee Pb, ?\exists x.Px)]$ consist of all worlds where *only* Ann went to the party and all worlds where *only* Bill went, respectively. None of these worlds is one where Ann and Bill *both* went to the party. For this result to obtain, it is crucial that exhaustification is defined in terms of minimization, à la Groenendijk and Stokhof (1984) and van Rooij and Schulz (2004). If we had stayed closer to the definition of exhaustification given by Zimmermann (2000), we would have had to apply exc independently of exh to achieve exclusive strengthening.

These all seem welcome results. However, there are at least three persisting problems. The first concerns the empirical claim that alternative questions generally involve exhaustivity, i.e., that the listed alternatives are generally supposed to be the only ones, from a contextually given set, that may hold. Consider examples like the following:

(246) Will JOHN attend the meeting today↑, or BILL↓?

(247) Is SUE↑ getting married today, or JOANNE↓?

Clearly, (246) implies that exactly one of John and Bill will attend the meeting today, but not that nobody else will—otherwise there wouldn't be much of a meeting. Similarly, (247) implies that exactly one of Sue and Joanne is getting married today, but not that nobody else is—otherwise there wouldn't be much of a marriage. Thus, assuming a direct connection between exhaustivity and list closure / falling intonation seems to *overgenerate* exhaustive readings, at least in the domain of alternative questions.

Examples like (246) and (247) perhaps still leave some leeway, because the context in which they are to be considered is not made explicit. However, as illustrated in (248) below, even if the context *is* made explicit and furnishes multiple alternatives besides those that are listed in the alternative question at hand, exhaustivity inferences do not necessarily arise.

(248) A: Who will be representing us tomorrow at the kickoff meeting?
B: Well, I know that if Sue is going then Bill and Tom will probably join her, and if Joanne is going then she is probably going with Tim and Frank. The key question is:
Is SUE going↑, or JOANNE↓?

The second problem does not concern alternative questions, i.e., closed interrogative lists with *multiple* items, but rather closed interrogative lists with a *single* item, exemplified in (249).

(249) Did AMY go to the party↓?

The logical form of this sentence is:

(250) [INT [CLOSED [C_{INT} did Amy go to the party]]]

Assuming that exhaustification takes place w.r.t. the general background question 'who went to the party', this logical form is translated as:

(251) $?\,\mathsf{exh}(Pa, ?\exists x.Px)$

Thus, the prediction is that (249) raises the issue whether or not Amy was the only person who went to the party. This is clearly not a good prediction. It seems, then, that direct connection between exhaustivity and list closure / falling intonation does not only overgenerates exhaustive readings in alternative questions, but also in closed polar interrogatives.

One way to avoid this second problem would be to assume that INT, rather than *ensuring* that its output is inquisitive by applying ? if its input is not already inquisitive, actually *presupposes* that its input is already inquisitive. This would render logical forms like (250) semantically illicit, and more generally, it would place a ban on singleton closed interrogative lists. However, while this would avoid the problem at hand, it would evidently beg the question how to conceive of polar interrogatives with a final fall, which are attested after all. If these cannot be analyzed as closed interrogatives, our theory leaves no other choice than to analyze them as open interrogatives. But then why are they pronounced with a final fall? It is possible of course that the fall signals something other than list closure in this particular case, e.g., some sense of urgency (indeed, it would be possible for the fall to signal something other than list closure exactly *because* interpreting it as signaling list closure would lead to semantic anomaly). For now, however, we will refrain from pursuing this possible solution in any further detail, because the third remaining problem, to which we turn now, really seems to strike the Zimmermann-inspired account of list closure at its heart, and seems insurmountable.

The third problem concerns answers to so-called *mention some* questions, and shows that a direct connection between exhaustivity and list closure / falling intonation does not only overgenerate exhaustive readings in interrogatives, but also in declaratives. This is illustrated by the question-answer pair in (252), a well-known example from the literature on mention-some questions, originally from Groenendijk and Stokhof (1982):

(252) Question: Where in Amsterdam can I get an Italian newspaper?
Answer: You can get one at the TRAIN STATION↓.

The question is called a mention-some question because it is typically used to elicit a response that just mentions some places in Amsterdam where Italian newspapers are sold, rather than an exhaustive list of such places. The answer, even though it is pronounced with a final fall, is indeed most naturally interpreted as just specifying one particular place where Italian newspapers are sold, and not as implying that this is the only place. Thus, even in the domain of simple declarative answers, list closure / falling intonation does not necessarily result in an exhaustive interpretation.

Notice that the problems that we just pointed out are not just problems for the particular implementation of the exhaustification operator that we suggested above. Rather, they are problems for the basic idea that closed lists generally involve a semantic exhaustification operator. They seem to suggest that the relevant exhaustivity inferences are *pragmatic* in nature rather than semantic. This is why, in developing our account, we focused just on exclusive strengthening, which we think *is* most naturally thought of as being semantic in nature (given the relevant intonation pattern, an exclusive interpretation seems to arise independently of the context of utterance, and moreover, the relevant intonation pattern has a distinctive distribution pattern which we have seen can be accounted for semantically).

Developing a pragmatic account of exhaustivity inferences that applies uniformly both to declarative answers and to alternative questions is certainly not a trivial affair either. Clearly, standard Gricean pragmatics does not do the job, because the Gricean maxims only prescribe how rational speakers are to behave in making informative contributions to a conversation (only say what you believe to be true, provide as much information as possible that is relevant with respect to the goal of the conversation, etcetera) and not how they should behave in making inquisitive contributions, i.e., in asking questions. However, the richer pragmatic theory of Westera (2013a,b) seems better suited for the taks at hand. Westera's maxims do not just concern the information that speakers provide, but also the possibilities that they *draw attention to*. Exhaustivity inferences arise on his account, roughly speaking, when a speaker refrains from drawing attention to a certain possibility, while doing so would have been relevant for the purposes of the conversation. Since drawing attention to possibilities is something that speakers do both in making informative statements and in asking questions, this pragmatic theory has the potential to explain exhaustivity inferences accross these different types of utterances in a uniform way. How exactly this is to be done is beyond the scope of the present work. We refer to Westera's ongoing work for a concrete proposal.

6.2 Alternative ways of implementing exclusive strengthening

The previous section related our notion of exclusivity at a conceptual level to two notions of exhaustivity that have been alluded to in previous work on alternative questions. In this section, we move from the conceptual level to a more technical level, and consider our actual implementation of the exclusive strengthening operator in comparison with some alternative implementations that are suggested by previous work, looking beyond the specific domain of alternative questions.

Pruning. Menéndez-Benito (2005) defined an exclusive strengthening operator in her analysis of *free choice* indefinites in the scope of modals. She uses this operator to derive, for instance, that a sentence like (253a) has the implication in (253b).

(253) a. You may pick any card.
b. Free choice inference: for every card x, it is allowed that you pick x and no other card

The same operator has been used by Balogh (2009) to capture answer exhaustivity, in Roelofsen and van Gool (2010); Pruitt and Roelofsen (2011) to capture the exclusive component of alternative questions, and in Aloni and Ciardelli (2013) to capture free choice inferences in imperatives.[33]

The operator is defined in the framework of alternative semantics, where the meaning of every sentence is construed as a set of alternatives. When applied to a set of alternatives A, it 'prunes' every alternative α in A in such a way that it no longer overlaps with any other alternative in A in which it was not fully contained to begin with. More formally:

(254) a. $\mathsf{prune}(\alpha, A) \coloneqq \{w \mid w \in \alpha \text{ and } w \notin \beta \text{ for any } \beta \in A \text{ such that } \alpha \not\subseteq \beta\}$
b. $\mathsf{prune}(A) \coloneqq \{\mathsf{prune}(\alpha, A) \mid \alpha \in A\}$

In inquisitive semantics, the meaning of a sentence is a downward closed set of information states, and the maximal elements of this set are called alternatives. Thus, the pruning operator as defined by Menéndez-Benito can be adapted to inquisitive semantics in a natural way. Namely, given a downward closed set of information states, we can apply the pruning operator to the alternatives in that set, and then include all subsets again to ensure downward closure.

(255) $\mathsf{prune}'(A) \coloneqq \{s \subseteq \alpha \mid \alpha \in \mathsf{prune}(\textsc{alt}(A))\}$

It turns out that this operation gives precisely the same results as our exclusive strengthening operator exc, at least if every element of A is contained in some alternative in $\textsc{alt}(A)$, i.e., if A does not contain any infinite sequences of ever-growing states. Let us refer to such propositions as *normal* propositions (Appendix **??** generalizes the result stated here to non-normal propositions).

(256) **Exclusive strengthening and pruning**
For any normal proposition A: $\mathsf{prune}'(A) = \mathsf{exc}(A)$.

To see that this holds, first suppose that $s \in \mathsf{prune}'(A)$. Then $s \subseteq \gamma$ for some $\gamma \in \mathsf{prune}(\textsc{alt}(A))$. This means that there is an alternative $\alpha \in \textsc{alt}(A)$ such that $\gamma = \mathsf{prune}(\alpha, \textsc{alt}(A))$, i.e.:

$$\gamma = \{w \mid w \in \alpha \text{ and } w \notin \beta \text{ for any } \beta \in \textsc{alt}(A) \text{ such that } \alpha \not\subseteq \beta\}$$

But since the alternatives in $\textsc{alt}(A)$ are maximal elements of A, one of them can never be contained in another, i.e., if $\alpha, \beta \in \textsc{alt}(A)$ then we always have that $\alpha \not\subseteq \beta$. Thus, the previous characterization of γ reduces to:

$$\gamma = \{w \mid w \in \alpha \text{ and } w \notin \beta \text{ for any } \beta \in \textsc{alt}(A)\}$$

But then for every $\beta \in \textsc{alt}(A)$ other than α itself, we have that $s \cap \beta = \emptyset$. Given our definition of exc, this means that γ is in $\mathsf{exc}(A)$, and by downward closure this must then also hold for s, which we assumed was contained in γ. This shows that $\mathsf{prune}'(A) \subseteq \mathsf{exc}(A)$.

Now let us prove the opposite inclusion. Suppose that $s \in \mathsf{exc}(A)$. Then $s \in A$ and there are no $\alpha, \beta \in \textsc{alt}(\varphi)$ such that $\alpha \neq \beta$, $s \cap \alpha \neq \emptyset$, and $s \cap \beta \neq \emptyset$. Since A is assumed to be normal, s must be contained in *some* alternative $\alpha \in \textsc{alt}(A)$. It follows, then, that for any *other* alternative $\beta \in \textsc{alt}(A)$, we must have that $s \cap \beta = \emptyset$. But that means that every world in s is in α and not in any other alternative $\beta \in \textsc{alt}(A)$, which in turn allows us to conclude that $s \subseteq \mathsf{prune}(\alpha, \textsc{alt}(A))$, and thus that $s \in \mathsf{prune}'(A)$. This shows that $\mathsf{exc}(A) \subseteq \mathsf{prune}'(A)$.

Thus, our exclusive strengthening operator yields precisely the same results as Menéndez-Benito's pruning operator, adapted in a natural way to inquisitive semantics. This is an important fact

[33] Check also Chierchia *et al.* (2012).

since it broadens the empirical motivation for the hypothesis that this operator plays a role in the interpretation of natural language expressions. While our present proposal suggests that it is part of the interpretation of disjunctive constructions with a certain intonation pattern, the work of Menéndez-Benito (2005), Aloni and Ciardelli (2013) and others suggests that it part of the interpretation of free choice indefinites as well. It is most likely not a coincidence that both constructions essentially involve an existential operator (disjunction, indefinites) with some special kind of marking (intonation, free choice morphology).

Given the result that our exclusive strengthening operators yields precisely the same results as a natural adaptation of Menéndez-Benito's pruning operator to inquisitive semantics, the question arises why we did not directly define our operator in a way that immediately reflects this similarity. We indeed have a specific reason for not having done this. Namely, the way we have defined exc, it directly operates on propositions, which are the primary semantic objects in inquisitive semantics, and not on sets of alternatives, which still play a distinctive role but are not the primary semantic objects in this framework. The adapted version of the pruning operator first has to do some 'pre-processing', going from the input proposition to the set of alternatives that it contains, then executes the actual pruning, and finally has to do some 'post-processing' again, adding subsets to ensure downward closure. The way we have defined it, exc operates in a more direct and straightforward way: it just takes a proposition and removes any element that is compatible with more than one alternative, without any pre- or post-processing.

Innocent exclusion. Alonso-Ovalle (2008) proposes a slightly different exclusive strengthening operator in alternative semantics, building on an earlier proposal by Fox (2007). We will refer to this operator as the *innocent exclusion* operator, and denote it as $\mathsf{innexclude}$. Just like Menéndez-Benito's pruning operator it operates in a pointwise fashion: given a set of alternatives, it strengthens every individual alternative relative to all the others.

(257) $\mathsf{innexclude}(A) \coloneqq \{\mathsf{innexclude}(\alpha, A) \mid \alpha \in A\}$

However, $\mathsf{innexclude}(\alpha, A)$ is defined differently from $\mathsf{prune}(\alpha, A)$. Namely, rather than substracting from α all alternatives in A that do not contain α, $\mathsf{innexclude}$ substracts from α all alternatives in A that are 'innocently excludable' given α, i.e., all alternatives that are contained in any maximal subset A' of A such that $\bigcup A'$ can be substracted from α without reaching inconsistency. We will denote this set of innocently excludable alternatives as $\mathsf{innexcludable}(\alpha, A)$:

(258) $\mathsf{innexcludable}(\alpha, A) \coloneqq \bigcap\{A' \mid A' \text{ is a maximal subset of } A \text{ such that } \alpha \setminus \bigcup A' \text{ is consistent}\}$

Given this characterization of $\mathsf{innexcludable}(\alpha, A)$, we can define $\mathsf{innexclude}(\alpha, A)$ as follows:

(259) $\mathsf{innexclude}(\alpha, A) \coloneqq \alpha \setminus \bigcup \mathsf{innexcludable}(\alpha, A)$

Finally, the innocent exclusion operator can be adapted to inquisitive semantics just like we did above with the pruning operator: given a downward closed set of information states, consider the maximal elements, apply $\mathsf{innexclude}$, and finally add all subsets again to ensure downward closure.

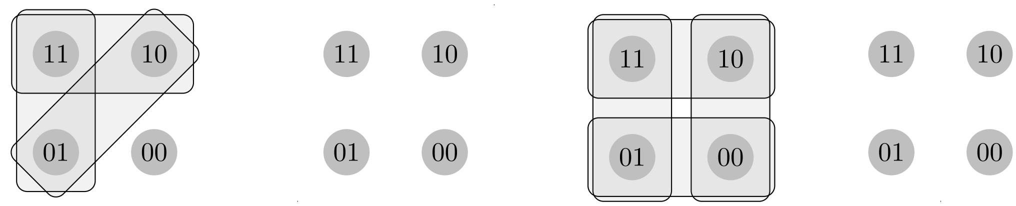
(260) $\mathsf{innexclude}'(A) \coloneqq \{s \subseteq \alpha \mid \alpha \in \mathsf{innexclude}(\textsc{alt}(A))\}$

The innocent exclusion operator is slightly more *cautious* than our own exclusive strengthening operator. To see this, consider the following two sentences, one a declarative and the other interrogative, both with the prosody that we take to convey exclusive strengthening.

(261) *Igor speaks ENGLISH↑, or FRENCH↑, or EXACTLY ONE OF THE TWO↓.

(262) *Does Igor speak ENGLISH↑, or FRENCH↑, or EXACTLY ONE OF THE TWO↓?

What is special about these cases is that neither disjunct can be true on its own, i.e., without



(a) φ (b) $\mathsf{exc}(\varphi)$ (c) ψ (d) $\mathsf{exc}(\psi)$

Figure 13: Two examples showing that when each alternative is jointly covered by the others, exclusive strengthening yields a contradiction; $\varphi := p \vee q \vee (p \leftrightarrow \neg q)$ and $\psi := p \vee \neg p \vee q \vee \neg q$.

one of the other disjuncts being true as well. For instance, if the first disjunct is true, i.e., if Igor speaks English, then it must either be the case that the second disjunct is true as well, i.e., that he also speaks French, or that the third disjunct is true, i.e., that he speaks exactly one of the two languages. It seems that all disjunctions with this property are infelicitous, no matter whether they are declarative or interrogative.

Setting exclusive strengthening aside for a moment, the infelicity of declarative disjunctions like (261) could in principle be explained in terms of *redundancy* (see Section 5.9). After all, ommiting any of the three disjuncts would not alter the proposition expressed by the sentence as a whole. Thus, these cases could be treated on a par with the Hurford cases that we saw above (e.g., **Igor was born in Paris or in France*).

However, such an explanation would not apply to interrogatives like (262). In this case, ommiting any of the disjuncts *would* alter the proposition expressed by the sentence as a whole. On our account, the infelicity of (262) can be explained instead by considering the effect of exclusive strengthening. As depicted in Figure 13(a), the disjunctive body of the list generates a proposition containing three alternatives, each of which is jointly covered by the other two. As depicted in Figure 13(b), applying exc to this proposition leads to a contradiction. This could explain why sentences like (262) are infelicitous.

A similar explanation can be given for cases like (263c).

(263) [Father to son: Tell me something about your new class. . .]

a. ✓Are there any GIRLS↑ or just GUYS↓?

b. ✓Are there any INTERNATIONAL students↑ or just DUTCH students↓?

c. *Are there any GIRLS↑, or just GUYS↑,
or any INTERNATIONAL students↑, or just DUTCH students↓?

Again, as depicted in Figure 13(c), each alternative is jointly covered by two of the other alternatives, and exclusive strengthening leads to a contradiction.

The innocent exclusion operator gives different results in these cases. To see this, consider the proposition depicted in Figure 13(a). Pick any of the three alternatives and call this alternative α. Call the other alternatives β and γ, and the set consisting of all three A. Now let us consider $\mathsf{innexcludable}(\alpha, A)$, i.e., the set of alternatives in A that are innocently excludable from α. To determine this set, we have to look at all the maximal subsets A' of A such that $\alpha \setminus \bigcup A' \neq \emptyset$. There are two such maximal subsets, namely $\{\beta\}$ and $\{\gamma\}$. For an alternative to be innocently excludable it has to be contained in *all* these subsets. But this does not hold for any alternative. It follows that $\mathsf{innexcludable}(\alpha, A)$ is empty, and that $\mathsf{innexclude}(\alpha, A)$ is just α itself. The same reasoning applies to β and to γ as well, of course, which means that $\mathsf{innexclude}(A)$ is just A, i.e., the innocent exclusion operator does not have any effect.

The same holds for the proposition depicted in Figure 13(c). Thus, unlike our exclusive strengthening operator, innocent exclusion does not provide an explanation for the infelicity of such cases.[34]

6.3 Exclusivity effects as Gricean implicatures

CONTINUE HERE

The exclusive interpretation of disjunctive assertions is standardly explained as a Gricean implicature (see, for instance, Gamut, 1991). The presumed pragmatic reasoning goes as follows. Suppose that Fred tells us that Sally brought wine or juice to the party. Suppose furthermore that we are in a situation where it would have been more helpful for Fred to have said that Sally brought *both* wine *and* juice to the party, if he had been in a position to do so. Third, suppose that if Sally had brought both wine and juice to the party, then Fred would have known about this. Finally, assume that Fred can be considered to be a cooperative interlocutor. Then we can conclude that Sally did not bring both wine and juice to the party. After all, if she did, then Fred would have known about it, and it would have been helpful for him to mention this to us; he didn't mention it, and we take him to be a cooperative interlocutor; so it cannot be the case that Sally brought both wine and juice to the party.

We have given an alternative account of exclusivity effects, and one may wonder whether this alternative account is really necessary, given the availability of the pragmatic account just sketched. There are a number of reasons why this is indeed the case. First, the Gricean account applies to disjunctive *assertions*, but it seems quite impossible for it to deal with disjunctive *questions*. One reason why this seems impossible is that the pragmatic account is not sensitive to differences in *intonation*, while a disjunctive question is only interpreted 'exclusively' (as an alternative question) if it has certain intonational characteristics. So a pragmatic account of the exclusive component of alternative questions seems out of reach.

But even if we restrict our attention to disjunctive assertions, there are certain cases where exclusivity effects can not be explained pragmatically, and intonation plays a crucial role. To see this, consider the following scenario:

(264) Ann organized a party, and many people brought all kinds of food and beverages. Now Ann wants to send out a big email to thank everyone who brought something, but she doesn't remember exactly who did and who didn't. So she asks her husband Fred:

(265) Did Sally bring anything?

And Fred answers:

(266) Yes, she brought wine↑ or juice↓.

Gricean reasoning does not predict (266) to be interpreted exclusively, because it would not have been more helpful for Fred to say that Sally brought both wine and juice in this scenario. And indeed, without the indicated intonation pattern the exclusive reading does not necessarilly arise in this context. However, *with* the indicated intonation pattern the exclusive reading does necessarilly arise. This means that, even if Gricean reasoning can explain exclusivity effects in some cases, we need an independent explanation for cases like (266), and this explanation needs to be sensitive to intonation. Our account of exclusive strengthening provides exactly such an explanation.

Notice that the essential feature of the scenario considered here is that it falsifies one of the assumptions that underly the Gricean account—in this case the assumption that it would have been more helpful for Fred to say that Sally brought both wine and juice. One could construct other scenarios falsifying one or more of the other assumptions that underly the Gricean account. In all

[34] One may wonder whether the very fact that innocent exclusion applies vacuously in these cases may provide an explanation for the infelicity. But this cannot be right, because then cases like (263a-b) and many others would wrongly be predicted to be infelicitous as well.

such cases, an exclusive interpretation of disjunction is forced by the pertinent intonation pattern, which requires a semantic explanation.

We could in fact go one step further and suggest that our account of exclusive strengthening may alleviate the Gricean account of exclusive disjunction from some of its persistent problems. To illustrate what these problems amount to, consider the following examples:

(267) Sally will bring wine↑ or juice↑ or champagne↓.

(268) a. Sally will bring wine↑ or juice↓.
b. Sally will bring wine↑ or juice↑ or both↓.

Examples like (267) raise a well-known issue for the Gricean account: it is not always quite clear what the 'alternatives' are that a given sentence should be compared to in order to derive its conversational implicatures. If the sentence at hand is of the form 'A or B', it may be plausible to take 'A and B' to be the only relevant alternative. But in the case of (267), which is of the form 'A or B or C', it is not so clear anymore how to decide in a principled way what the relevant alternatives are. Taking 'A and B and C' to be the unique relevant alternative, for instance, does not lead to the desired result. Several proposals have been made in this regard (cf. Sauerland, 2004; Fox, 2007; Katzir, 2007), but the general debate concerning this issue is still quite open.

Examples like (268a-b) raise another issue for the Gricean account, at least if such an account is based on a classical truth-conditional semantics. The problem, observed by Alonso-Ovalle (2006), is that (268a) is truth-conditionally equivalent to (268b). Thus, assuming a classical semantics, it is difficult, if not impossible, to derive pragmatically that (268a) is interpreted exclusively, while (268b) is not. Alonso-Ovalle (2006) proposes to solve this problem by adopting an alternative-based semantics, similar to the one adopted in this paper. Once (268a) and (268b) are semantically distinguished, there is new hope for a pragmatic theory that derives an exclusive reading for (268a) but not for (268b).

However, it may well be that all these efforts to ammend the Gricean account of exclusive disjunction are ultimately quite unnecessary. For, the relevant facts immediately fall out of the analysis proposed here, which, unlike most previous analyses, takes intonation into consideration.

6.4 Exclusive strengthening and scalar strengthening

Our account of exclusive strengthening is reminiscent of Kadmon and Landman's (1993) theory of NPI licensing, and further developments of this theory by Krifka (1995), Lahiri (1998), and Chierchia (2004), among others. Kadmon and Landman's central assumptions are (1) that NPIs are *domain wideners*, i.e., they differ from ordinary indefinites in that they quantify over a wider domain, and (2) that NPIs are licensed only if this domain widening strengthens the overall informative content of the sentence. Evidently, this second assumption is intimately related with our strengthening condition.

Interestingly, exclusive strengthening and domain widening are opposites in a way: exclusive strengthening is, as the name suggests, in itself a strengthening operation, while domain widening is weakening. Therefore, the distribution of exclusive strengthening operators and NPIs is also quite complementary: NPIs are only licensed in downward monotonic environments (which turn the weakening effect of domain widening into an overall strengthening effect), while exclusive strengthening operators are licensed only in upward monotonic environments. Neither NPIs nor exclusive strengthening operators are licensed in non-monotonic environments.

Chierchia (2004) relates NPI licensing to another phenomenon, which we will refer to as *scalar strengthening*. Chierchia argues that scalar items by default give rise to strengthened semantic values, which are computed compositionally, alongside ordinary semantic values. We have adopted the same general architecture, where ordinary and strengthened semantic values are computed in parallel. Moreover, the assumed effect of exclusive strengthening is very similar in nature to that of scalar strengthening: it leaves the ordinary semantic value in tact, but affects the strengthened semantic value.

In fact, given that disjunction is a scalar item, one could ask whether exclusive strengthening should perhaps be viewed as a special instance of scalar strengthening. However, there are some important differences between the two mechanisms, which suggest that one cannot be reduced to the other in any straightforward way.

One way in which scalar strengthening differs from exclusive strengthening is that it always makes reference to *scalar alternatives* of the item that triggers strengthening. For instance, scalar strengthening of *Sally ate some of the cookies* is defined in terms of the scalar alternative *Sally ate all of the cookies*. Similarly, scalar strengthening of *Sally brought wine or juice* is defined in terms of the scalar alternative *Sally brought wine and juice*. Exclusive strengthening is not defined in terms of scalar alternatives. It applies to a single semantic value, and strengthens this value without comparing it to anything else.

A second difference is that exclusive strengthening is associated with a specific intonation pattern, while scalar strengthening is assumed to happen automatically, independently of intonation, whenever the compositional interpretation procedure encounters a scalar item.[35] This makes it difficult to see how the prosodic disambiguation of disjunctive questions—the main concern of the present paper—could be explained in terms of scalar strengthening. Even if the exclusive component of alternative questions could be derived in terms of scalar strengthening,[36] we would still need to explain why strengthening only arises in disjunctive questions with a certain intonation pattern.[37]

A third difference between Chierchia's system and ours concerns the strengthening condition. Chierchia assumes, as we do, that the computation of strengthened semantic values is subject to a general strengthening condition. However, there are several implementational differences. First, Chierchia's strengthening condition is formulated in terms of classical entailment, whereas we explicitly argued for a formulation in terms of inquisitive entailment. Second, in cases where Chierchia's condition is violated, the strengthened value is *recalibrated*, which roughly means that it is 'reset' to the ordinary semantic value: the effect of scalar strengthening is canceled, but this does not lead to ungrammaticality. Violation of our strengthening condition does lead to ungrammaticality. This is necessary to account for examples like (66) and (68). Chierchia's strengthening condition predicts that the effect of scalar strengthening is canceled in these examples, but not that the sentences are ungrammatical.

Finally, Chierchia's strengthening condition requires that the strengthened semantic value never becomes weaker than the ordinary semantic value, whereas our condition requires that the strengthened value always remains at least as strong as the ordinary value. Thus, in cases where the ordinary value and the strengthened value become *incomparable*—i.e., where neither one is stronger than the other—Chierchia's condition is satisfied, whereas our condition is violated. This typically happens when strengthening occurs in the scope of a non-monotonic quantifier:

(269) Exactly one girl drank wine or juice.

[35] Sometimes the effect of scalar strengthening is 'recalibrated' at some later stage in the compositional interpretation procedure (see below). Whether this happens or not depends, essentially, on whether the scalar item occurs in the scope of a downward monotonic operator. Crucially, it is not taken to depend on intonation.

[36] Chierchia's system does not explicitly deal with interrogatives. Extending his system in order to account for the exclusive component of alternative questions does not seem to be a trivial affair, but it may not be impossible.

[37] Fox and Spector (2009) argue that intonation affects the set of *alternatives* that play a role in scalar strengthening. What is particularly significant, they argue, is whether or not there is a nuclear pitch accent on the scalar item in question (e.g., on the word *or*). According to Fox and Spector, the presence or absence of such a nuclear pitch accent affects the focus semantic value of the scalar item, and thereby constrains the alternatives that play a role in scalar strengthening. However, the presence of a nuclear pitch accent on *or* does not seem to play a disambiguating role in disjunctive questions. It does not seem to favor, for instance, an alternative question interpretation over a yes/no question interpretation or an open question interpretation. All three interpretations can be obtained with or without a nuclear pitch accent on *or*. So it seems that the kind of intonation-sensitivity of scalar strenghtening that Fox and Spector point out does not directly bear on the issues considered in this paper.

Chierchia observes, without making explicit reference to intonation, that this sentence has an *inclusive* reading, on which there was exactly one girl who drank wine or juice or both, and an *exclusive* reading, on which there was exactly one girl who drank exactly one of the two mentioned beverages (there may have been several other girls who drank both). These two readings correspond to the ordinary and the strengthened semantic value in Chierchia's system. Crucially, Chierchia's strengthening condition is satisfied in this case, because the strengthened semantic value is *not weaker* than the ordinary semantic value. If our strengthening condition applied to scalar strengthening, it would be violated in this case, since it requires that the strengthened semantic value be *at least as strong* as the ordinary semantic value, which it is not. Thus, as far as scalar strengthening is concerned, it seems that Chierchia's strengthening condition is more suitable than ours.

However, when we turn to exclusive strengthening, is seems that our own strengthening condition is more suitable. For instance, it accounts for the observation, already made above, that if (269) is pronounced with the intonation pattern that signals exclusive strengthening, it only has a *wide scope* exclusive reading, and not Chierchia's *narrow scope* exclusive reading (nor his narrow scope inclusive reading). Thus, there are good reasons why Chierchia's strengthening condition is formulated as it is, and there are also good reasons why our strengthening condition is formulated as it is. Even though there appears to be an intimate connection between the two at a conceptual level, a unification does not seem to be straightforwardly achievable.

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