Alternative questions in a trivalent semantics

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Abstract

Disjunctive questions like *Did John bring the beer or the wine?* are ambiguous between a polar and an alternative question interpretation, correlating with particular intonation patterns. Under the former interpretation, *yes* is an acceptable response as soon as John brought one of the beer and the wine, and *no* is so if he brought neither. Under the latter interpretation, however, the addressee is asked to specify which one of John bringing the beer and John bringing the wine is true, assuming that exactly one of them is true. I argue that this difference comes about as follows. *Or* takes scope above the question operator in the alternative question interpretation resulting in a disjunction of polar questions, but below it in the polar interpretation. The particular intonation patterns reflect this difference in scope. The exactly-one meaning component of alternative questions is tied to this difference as well: first, the question operator is argued to be presuppositional. Second, assuming a Strong Kleene semantics, this presupposition when embedded under *or* projects in the way characteristic of disjunction in general. This is shown to derive the desired exactly-one component as a presupposition.

1 Introduction

When a disjunctive question shows a rising intonation (indicated by /), as in (1), it is usually interpreted as a polar question. That is, both *yes* and *no* naturally qualify as answers. In particular, *yes* counts as a felicitous response if John brought at least one of the two things mentioned, and *no* does so if he brought neither. I refer to questions like the one in (1) as polar disjunctive questions (PDQs).

(1) Q: Did John bring the beer or the wine/?
A: Yes. / No.

If the disjunctive question, however, has pitch accents on the disjuncts and a rise-fall intonation (indicated by capital letters and /\, respectively), as in (2), it is interpreted as an alternative question (AQ). Now a simple *yes*- or *no*-response does not suffice. First, the AQ has a true alternative meaning component: the addressee must choose which of the alternatives in (2A) is true, ruling out *neither* as a response. Second, the AQ has an exclusivity component according to which only one of the alternatives is true, as evidenced by the unnaturalness of a *both*-response. Taken together, AQs thus have an exactly-one meaning component.

(2) Q: Did John bring the /BEER or the WINE\?
A: He brought the beer. / He brought the wine.

A′: #Yes. / #No.
A′′:#Both. / #Neither.

The contribution of *or* in PDQs is intuitively of a different nature than in AQs. How do the two interpretations come about compositionally? Relying on Polish data, I suggest the following: disjunction scopes above the question operator in AQs in contrast to PDQs, and the respective intonation patterns reflect this difference in scope. I argue that the explanatory challenge raised by this is to connect not only the denotational differences between the two types of disjunctive questions but also the exactly-one meaning component specific to AQs to the difference in scope.

This is done via a compositional analysis of AQs based on the following ingredients. The question operator conforms to Karttunen's 1977 general one with one twist: the identity relation between propositions built into this operator is a presupposition. Questions thereby come with a presupposition as to which propositions they can map to true or false. The pitch accents in the disjuncts of AQs are argued to be indicative of mutually exclusive foci. Their presence is motivated by an independent theory about redundancy in grammar. The final crucial ingredient is a trivalent semantics, in particular a Strong Kleene semantics. The combination of all this derives the exactly-one meaning component of AQs as an instantiation of the presupposition projection pattern of trivalent disjunction.

The paper is structured as follows: section 2 discusses general properties of disjunctive questions and the issues raised by them. Section 3 introduces the crucial Polish data and discusses the explanatory challenge. Section 4 provides the core of the proposal. Section 5 extends this by discussing the pragmatics and embedding of disjunctive questions. Section 6 locates the account in a cross-linguistic setting and compares it to existing proposals. Finally, section 7 concludes the paper.

2 Properties of disjunctive questions

2.1 Intonational and syntactic properties of disjunctive questions

A few remarks about the assumptions regarding intonation are in order. I follow Bartels (1999) in this (see also Truckenbrodt 2012, Pruitt and Roelofsen 2013).

There are at least two possible canonical intonation patterns for the PDQ in (1), given in (3). The intonation in polar questions is generally due to high phrasal and boundary tones (H- and H%, respectively) at the end of the question — that is, on the final disjunct in the case at hand. The question constitutes one prosodic phrase (indicated by round brackets). Moreover, there is a pitch accent on the final disjunct and an optional one on the non-final disjunct (indicated by underlining). These are associated with a high or a low tone, i.e, H* or L* respectively.

(3) Did John bring the beer or the wine/?
(H* H* H-H%)
(L* L* H-H%)

The AQ in (2) has at least two possible intonational representations, given in (4). The final fall is due to a pitch accent on a high tone in the final disjunct followed by low phrasal and boundary tones. The two disjuncts constitute separate prosodic

phrases. So in addition, there is an obligatory pitch accent, associated either with a high or a low tone, together with a high phrasal tone on the non-final disjunct. In case the pitch accent is on a low tone, an impression of rising intonation on the non-final disjunct results.

(4) Did John bring the /BEER or the WINE\?
(H* H-) (H* L-L%)
(L* H-) (H* L-L%)

In the following, I will not indicate pitch accents on PDQs given that a pitch accent on a non-final disjunct is optional. As a consequence, the term *final rise intonation* is not meant to include any implication regarding pitch accents but solely refers to the high tones at the end of a polar question. *Final fall intonation*, on the other hand, will mean that there are both final low tones and obligatory pitch accents on the disjuncts in AQs.[1]

It should be noted that both PDQs and AQs allow for the disjunction of various syntactic categories as the following pairs of examples show:[2]

(5) a. Did John bring the beer or eat the pork/?
b. Did John /drink the BEER or eat the PORK\?

(6) a. Did John bring the beer or Jack eat the pork/?
b. Did /John drink the BEER or Jack eat the PORK\?

(7) a. Did John bring the beer or did Jack eat the pork/?
b. Did /John drink the BEER or did Jack eat the PORK\?

Finally, it should be mentioned that the disjunction of subjects also allows for both the PDQ and the AQ interpretation:

(8) a. Did John or Bill bring the beer/?
b. Did /JOHN or BILL\ bring the beer?

2.2 The nature of the exactly-one meaning component

Turning now to the semantic properties of disjunctive questions, consider once more the difference between the PDQ in (9) and the AQ in (10) together with what were claimed to be natural and not so natural responses.

(9) Q: Did John bring the beer or the wine/?
A: Yes. / No.

(10) Q: Did John bring the /BEER or the WINE\?
A: He brought the beer. / He brought the wine.
A′: #Yes. / #No.

[1] So-called open disjunctive questions will be discussed in section 5.3.2.

[2] Three remarks are in order. First, with the exceeding lengths of the examples, acceptability of the PDQs might deteriorate. This is presumably due to the fact that PDQs are allowed to have only one prosodic phrase. This effect can be neutralized by making the disjuncts completely contrastive. Second, in addition to the indicated focal stress in AQs, there might be contrastive stress on the verbs in (5b) and on the subjects in (6b) and (7b). Finally, (7a) on the surface looks like a disjunction of polar questions. See section 3.1 for discussion.

A″:#Both. / #Neither.

The AQ in (10) calls for an answer specifying which of the alternatives provided by the answers in A is true. The speaker of the question appears to take the truth of at least one of the alternatives for granted as the unnaturalness of *neither* as a response shows. I refer to this as the *true alternative requirement.* The speaker also expects not more than one of the alternatives to be true since *both* is an equally unnatural response. I refer to this latter condition as the *mutual exclusiveness requirement.* Together they constitute the exactly-one meaning component of AQs.

Neither of these requirements is to say that *both* and *neither* cannot be used as responses to an AQ at all, of course. As A and A′ in (11) show, such responses are indeed possible, but it appears that they are best when used with some collocation — such as *well actually* in A and A′ — making clear that the speaker of the question made too strong an assumption (see Biezma and Rawlins 2012).

(11) Q: Did John bring the /BEER or the WINE\?
A: Well actually, he brought both.
A′: Well actually, he brought neither.

A PDQ lacks both the true alternative and the mutual exclusiveness requirement, as the infelicity of A and A′ to such a question in (12) shows. A and A′ are infelicitous because the presence of *well actually* contributes that the speaker made too strong an assumption with her question even though she did not. From this minimal difference between (11) and (12) we draw the conclusion that the two requirements are integral to AQs only.[3]

(12) Q: Did John bring the beer or the wine/?
A: #Well actually, he brought both.
A′: #Well actually, he brought neither.

The true alternative requirement is usually taken to be a presupposition (Karttunen and Peters 1976, Groenendijk and Stokhof 1984, Romero and Han 2003, Biezma and Rawlins 2012 a.o.). With regards to the mutual exclusiveness requirement opinions differ. Some see it as a presupposition, conventional implicature, or some other non-assertive component (e.g. Karttunen and Peters 1976, Romero and Han 2003, Pruitt and Roelofsen 2011, Biezma and Rawlins 2012 a.o.). Others consider it a conversational implicature and thus cancellable (e.g. Groenendijk and Stokhof 1984, Groenendijk and Roelofsen 2009 a.o.). von Fintel's 2004 *Hey, wait a minute*-test, though, suggests that both inferences of AQs are presuppositions — that is, assumed to be part of the common ground. The use of *Hey, wait a minute* is only felicitous when a speaker's presupposition is targeted in order to point out that it is too strong an assumption (but cf. Pearson 2010 for some qualifications):

(13) Q: Did John bring the /BEER or the WINE\?
A: Hey, wait a minute, ...
(i) I didn't know that John couldn't have brought both.

[3]The labels *true alternative requirement* and *mutual exclusiveness requirement* are meant purely descriptively here to characterize particular semantic properties of AQs. They make reference to the assumed truth and falsity of the *disjuncts* of such a question qua answers.

(ii) I didn't know that John couldn't have brought neither.

Moreover, note that embedding of the AQ in (14) under the rogative predicate *ask* (Lahiri 2002) suggests that Mary believes that John brought exactly one of the two things mentioned. This shows two things: first, the mutual exclusiveness requirement is part of the meaning of (14) which is not straightforward to reconcile with it being a conversational implicature given that the question is embedded. Second and more importantly, this inference is affected by the embedding predicate, a property typical of presuppositions (Karttunen 1974, Heim 1992 a.o.).

(14) Mary asked whether John brought the /BEER or the WINE\.

A parallel point can be made with the conditional interrogative in (15), which does not inherit the exactly-one requirement of the AQ in the consequent. This is immediately explained if it is a presupposition filtered by the antecedent of the conditional (see Biezma and Rawlins 2012).[4]

(15) If John brings exactly one thing, will he bring the /BEER or the WINE\?

I thus take it that both the true alternative and the mutual exclusiveness requirements are presuppositions. Consequently, a successful explanatory account of AQs should derive the exactly-one component from the compositional semantics.

2.3 The interpretation of disjunctive questions

A widespread view concerning the interpretation of polar questions is that they raise an issue; namely the issue of which of two mutually exclusive states of what the world could be like is the case. One state for the PDQ in (16a), for instance, would be the one where John brought beer or wine, and the other the one where John brought neither. I assume in the following that such states are to be thought of as sets of worlds or propositions. There are different ways of cashing out this intuition. First, (16a) might denote the set containing exactly the two propositions conforming to the two opposing states (Hamblin 1973, Karttunen 1977 a.o.), as in (16b). In an inquisitive semantics, (16a) would denote the set containing these two propositions plus all logically stronger ones (Ciardelli et al. 2013 a.o.). In a partition-semantics for questions, (16a) would denote the proposition conforming to the true state of the world (Groenendijk and Stokhof 1982, 1984) — i.e., one of the two propositions in (16b) varying with the state of the world.[5]

[4] I thank a reviewer for drawing my attention to Biezma and Rawlins's 2012 related example (37). Their own example sounds a bit degraded for what I believe to be independent reasons.

[5] A number of arguments have been produced for adopting Groenendijk and Stokhof's 1982 semantics over Karttunen's 1977 approach. The one stemming from embedded questions has been reconciled with the latter by adopting Heim's 1994 answer operator (see section 5.4.1). The remaining issues have to do with conjunction and negation. For instance, not any two questions can be directly conjoined by intersection. At the embedded level, Heim's answer operator avoids this issue by allowing for the conjunction of an answer to a question — i.e., a proposition — with another proposition (see section 5.4.1). At the root level, possibly Krifka's 2001b conjunction at the speech-act level might be of help (see section 5.3.2). Ciardelli et al.'s 2013 framework conceptually diverges from Karttunen's approach in making the propositions resolving the issue defined by the question central rather than its answers. A side-effect of this is that the problems just noted are avoided. Further, Ciardelli et al. (2015:chapter 5) note possible advantages over a Karttunen-framework: the

(16) a. Did John bring the beer or the wine/?
b. {λw. John brought the beer or the wine in w, $\lambda w.\neg$John brought the beer or the wine in w}

Let me put these differences aside for a moment. First, the issues to be discussed are somewhat theory-independent and thus apply to all semantic approaches to questions. Second, section 4 will argue for yet another approach anyway. But since that approach shares certain similarities with Karttunen's, I briefly discuss his view here to outline the issues raised by disjunctive questions. Take (16a) to have the LF in (17). There is a yes-no question-operator $?_{yn}$ embedding the overt linguistic material with the lexical entry in (18). It takes the proposition that John brought the beer or the wine and returns the characteristic function of the set containing the propositions that are equivalent to that proposition or to its negation. This delivers as denotation for (16a) the characteristic function of the set in (16b).

(17) [$?_{yn}$ [John brought the beer or the wine]]

(18) $[\![?_{yn}]\!] = \lambda p_{st}.\lambda q_{st}.q = p \vee q = \lambda w.\neg p(w)$

It is much less clear what the compositional semantics for the AQ in (19), repeated from above, should look like.

(19) Did John bring the /BEER or the WINE\?

Consider first the issue of what the denotation should be like. Two prima facie plausible options come to mind. On the one hand, one might take the denotation of (19) to be the set of propositions in (20) (e.g. von Stechow 1990, Bittner 1998, Romero and Han 2003, Beck and Kim 2006, Biezma and Rawlins 2012, Uegaki 2014). Note that additional ingredients must guarantee that exactly one of the propositions in the set is true, i.e., to generate the exactly-one meaning component.

(20) {λw. John brought the beer in w, λw. John brought the wine in w}

On the other hand, one might eschew at least one such additional component and assume that the denotation of (20) corresponds to the set of the mutually exclusive propositions in (21) (see Pruitt and Roelofsen 2011, Haida 2013, Nicolae 2013, Howell 2016 a.o.). (21) guarantees that only one of the propositions can be true.

(21) {λw. John brought the beer but not the wine in w, λw. John brought the wine but not the beer in w}

Even in this second kind of approach one is in need of an additional mechanism to derive the true alternative requirement, though, as both propositions in (21) might be false.[6] At any rate, ideally the true alternative and the mutual exclusiveness

status of the notion of answer (see sections 4.2.2 and 4.2.4), of the notion of entailment for questions, and of Hurford's constraint in questions (see section 5.1). Detailed comparison is left for future research. Finally, it must be mentioned that a more expressive, structural meaning approach to questions has also been argued for (e.g. von Stechow 1990, Krifka 2001a).

[6] In an inquisitive semantics à la Ciardelli et al. (2013) the denotation would moreover contain all the logically stronger propositions in addition to those in (20) or (21). On Groenendijk and Stokhof's 1982 account, (19) would denote either one of the propositions in (21) or one of *that John brought the beer and the wine* and *that John brought neither wine nor beer.* Also on these accounts one

requirements fall out as by-products of the compositional semantics adopted. That is, it is desirable to have a tight connection between the compositional semantics deriving a particular AQ denotation and the exactly-one meaning component.

Moreover, regardless of whether (20) or (21) is chosen as the denotation of AQs, the semantic contribution of disjunction is not as straightforward as in the case of PDQs. Clearly, the disjunctive proposition that John brought the beer or the wine does not play a role in the interpretation of (19). But then what is disjoined here? Broadly speaking two types of approaches can be found in the literature to this problem. The first type of account concludes that the disjunction used in an AQ forms a particular set of propositions — e.g., (20)— thereby generating the question denotation (see von Stechow 1990, Bittner 1998, Romero and Han 2003, Beck and Kim 2006, Biezma and Rawlins 2012 a.o.). This often goes hand in hand with a special semantics for disjunction, which can then in principle be extended to PDQs as well. The second type of approach is based on the assumption that the disjunction in an AQ is what we always thought it was. It applies, however, at a level different from the one found in PDQs, namely at the question-level (Karttunen 1977). There are different ways of implementing this. First, AQs might be disjunctions of polar questions (Haida 2013, Pruitt and Roelofsen 2011, Uegaki 2014). Second, the disjunction might apply at some lower level but be scoped above the question operator (Groenendijk and Roelofsen 2009, Nicolae 2013).

Finally, the differing denotations of the two types of disjunctive questions and also the exactly-one presupposition of AQs must be brought in line with the differing intonation patterns. Here again two sub-issues arise. First, why are the pitch accents seemingly obligatory in AQs but not in PDQs? Second, why can AQs only show the final fall and PDQs only the final rise intonation?

3 Disjunction of polar questions

In the present section, I argue that AQ interpretations correlate with question-level scope for disjunction.

3.1 The importance of disjoined full polar questions

Belnap and Steel (1976) note that the disjunction of full polar questions only allows for an AQ interpretation (see also Biezma and Rawlins 2012). (22a) is therefore ungrammatical because the absence of the final fall intonation forces a PDQ interpretation for the embedded clause, which clashes with the requirement noted by Belnap and Steel.[7] (22b), on the other hand, is acceptable because the final fall intonation is compatible with the requirement.[8]

must therefore ask how the exactly-one meaning component comes about.

[7]Embedded polar questions generally do not show a final rise intonation (Truckenbrodt 2012).

[8]Given such facts Szabolcsi's 1997 and Krifka's 2001b claims that disjunctions of questions are non-existent appear too strong. Krifka, in particular, discusses the degradedness of overt disjunctions of wh-questions. Ciardelli et al. (2015) however, note that such disjunctions are possible (see also Haida and Repp 2010, Szabolcsi 2015). I adjusted the order of *we* and *can* in (i).

(i) Peter is investigating where we can rent a car or who might have one that we could borrow. (Ciardelli et al. 2015:13)

(22) a. *Maria asks whether Anna bought a blouse or whether she bought a skirt.
b. Maria asks whether Anna bought a /BLOUSE or whether she bought a SKIRT\.

Haida (2013) notes that Belnap and Steel's 1976 observation is not always true for disjunctions of full matrix polar questions. (23a) can be answered by *yes* and *no*. It thus has a PDQ reading. Final fall intonation as in (23b) forces an AQ reading.

(23) a. Have you graduated or will you graduate from college?
(Haida 2013:(22))
b. /HAVE you graduated or WILL\ you graduate from college?

Embedding (23a) and (23b) as in (24a) and (24b), respectively, shows a different picture, however. Only the sentence in (24b) with a final fall intonation is acceptable, and it can only have an AQ interpretation. (23a) should thus not be seen as a counterexample to Belnap and Steel's 1976 observation. The patterns in (23) and (24) rather show that *whether* but not auxiliary inversion is a good indicator for the presence of a polar question.

(24) a. *Fill in whether you have graduated or whether you will graduate from college.
b. Fill in whether you /HAVE graduated or whether you WILL\ graduate from college.

The LFs of the embedded clauses in (22) and (24) necessarily encompass two full polar questions as represented for the former in (25). That is, the disjunction necessarily scopes over two polar questions. If this for some reason forces an AQ interpretation, the acceptability patterns would follow.

(25) [whether [Anna bought a blouse]] or [whether [she bought a skirt]]

Something along the lines just described must be true, it seems. But based on the assumption that question-level scope of disjunction forces the AQ interpretation in (22) and (24) we can entertain the following hypothesis regarding the AQ example in (26). Maybe also in this case disjunction scopes at the question-level. That is, maybe an AQ interpretation generally correlates with question-level scope for disjunction (as suggested by Karttunen 1977, Haida 2013, Pruitt and Roelofsen 2011, Uegaki 2014 a.o.). There could be two ways for question-level scope to arise in (26) broadly speaking. The first would be by an LF parallel to (25) as in (27) where strikethrough indicates material that is left unpronounced because of ellipsis of non-contrasting material (Han and Romero 2004a). I assume for the sake of simplicity that the indefinites can be interpreted in their surface position.

(26) Maria asks whether Anna bought a /BLOUSE or a SKIRT\.

(27) [whether [Anna bought a blouse]] or [~~whether~~ [~~Anna~~ ~~bought~~ a skirt]]

The second option would be to have disjunction occur overtly below the question marker *whether* accompanied by some LF scoping mechanism (e.g. Groenendijk and Roelofsen 2009, Nicolae 2013). For instance, disjunction could receive scope

over the question marker via covert movement as in the LF in (28).

(28) [[a blouse] or [a skirt] 2[whether [Anna bought t_2]]]

A reviewer mentions the relevance of AQs such as (29a) in this respect. Here the disjunctive phrase is embedded in a relative clause, an island for over movement as shown by (29b). Therefore, if covert movement as in (28) is subject to islands, clause-level scope for the disjunction in (29a) would only be achievable via ellipsis of non-constituents as hypothesized in (27).

(29) a. Do you need a person who speaks Dutch or Russian?
b. *What do you need a person who speaks? (Beck and Kim 2006:190)

Does such ellipsis of non-constituents exist? (30) on the surface appears to be coordination of non-constituents, which is often taken as evidence for the existence of such ellipsis (see e.g. Wilder 1997, Hofmeister 2010, Bruening 2015, but cf. Sailor and Thoms 2013). That is, (30) is said to have a structure like (31). If so, (29a) might not be problematic. I must leave this issue for future research.

(30) Anna bought a blouse on Thursday and a skirt on Friday.

(31) [Anna bought a blouse on Thursday] and [~~Anna bought~~ a skirt on Friday]

The other side of the hypothesis mentioned would be that a PDQ interpretation is averse to question-level scope for disjunction. (32) would thus be acceptable with a PDQ interpretation because nothing forces a disjunction of two polar questions. That is, its LF could be as in (33).

(32) Maria asks whether Anna bought a blouse or a skirt.

(33) [whether [Anna bought [a blouse] or [a skirt]]]

We should thus contemplate the hypothesis in (34). Can it be substantiated?

(34) *Disjunctive question hypothesis*
a. AQs correlate with scope for disjunction at the question-level.
b. PDQs correlate with scope for disjunction below the question-level.

3.2 The facts from Polish

In Polish, disjunction in assertions is expressed by the morpheme *albo*:

(35) Anna kupiła bluzkę albo spódnicę.
Anna bought blouse albo skirt
'Anna bought a blouse or a skirt.'

Polish shows a peculiar picture regarding disjunctive questions. As (36) shows, in that language PDQs are formed with the disjunctive marker *albo*, as one would expect given (35).

(36) Q: Anna kupiła bluzkę albo spódnicę/?
Anna bought blouse albo skirt
'Did Anna buy a blouse or a skirt?'

A: Yes. / No.

Note that the polar question in (36) shows final rise intonation, parallel to the English cases discussed so far. In contrast to English, however, *albo* with a final fall intonation cannot give rise to an AQ as evidenced by (37b).[9] Such an example can only be interpreted as an assertion, (37a). This is unexpected given our discussion of English disjunctive questions.

(37) Anna kupiła /BLUZkę albo spódNIcę\
Anna bought blouse albo skirt
a. 'Anna bought a blouse or a skirt.'
b. #'Which of a blouse or a skirt did Anna buy?'

Interestingly, an AQ interpretation is only possible with *czy* instead of the disjunctive marker *albo*. The answers show that we are indeed dealing with an AQ:.[10]

(38) Q: Anna kupiła /BLUZkę czy spódNIcę\?
Anna bought blouse czy skirt
'Which of a blouse or a skirt did Anna buy?'
A: A blouse. / A skirt.
A′: #Yes. / #No.
A′′:#Both. / #Neither.

The AQ in (38) is accompanied by final fall intonation. With such an intonation, the sentence cannot be used as an assertion, as shown in (39), in contrast to the parallel sentence with *albo* in (37).

(39) Anna kupiła /BLUZkę czy spódNIcę\
Anna bought blouse czy skirt
a. #'Anna bought a blouse or a skirt.'
b. 'Which of a blouse or a skirt did Anna buy?'

Finally, *czy* also cannot be used when a polar question interpretation is intended, as (40) shows. In fact, *czy* with final rise instead of final fall intonation is degraded.

(40) *Anna kupiła bluzkę czy spódnicę/?
Anna bought blouse czy skirt

These data clearly show that PDQs and AQs in Polish differ not only in their intonation but also in, at least, their morphological set-up.

3.3 Polish as support for the disjunctive question hypothesis

Given that *czy* cannot occur in an assertion, we should conclude that it is somehow tied to question environments and more in particular to AQs. Recall now that I put forward the hypothesis that an AQ interpretation correlates with scope for

[9] When discussing data from languages other than English, I often use a *which*-question as the English translation for AQ examples to set them apart from the polar interpretation.

[10] The disjunctive morpheme *lub* also exists. Its distribution is tangential to the present concerns. Bittner (1998) and Haida (2013) discuss the fact that Polish apparently employs differing disjunctive markers for PDQs and AQs. They do not discuss intonation, which will be seen to be crucial.

disjunction at the question-level (34a) and a PDQ interpretation with scope below the question-level (34b). The Polish data discussed support this hypothesis.

3.3.1 Proposition-level scope and *albo*

First, *albo* and *czy* are in complementary distribution with respect to disjunction in AQs. Moreover, *albo* is arguably the unmarked disjunctive marker in Polish. Disjunction in assertions by definition cannot have question-level scope. Since assertions and PDQs both use *albo*, a natural assumption is that *albo* has the same scope here, namely at the proposition-level. The LF for the embedded PDQ in (41) would thus be as in (42). Indeed, (42) is the standard representation for PDQs.

(41) Maria pyta, *(czy) Anna kupiła bluzkę albo spódnicę.
Maria asks czy Anna bought blouse albo skirt
'Maria asks whether Anna bought a blouse or a skirt.'

(42) [czy [Anna kupiła [bluzkę] albo [spódnicę/]]]

Notice that there is a *czy* in (41). The reason for this is that the *czy* seen so far in AQs is homophonous with the general question marker in Polish. That is, *czy* in (42) marks the question-level. Embedded simple polar questions such as (43) but also embedded AQs as in (44) are mandatorily marked by *czy*.

(43) Maria pyta, *(czy) Anna kupiła bluzkę.
Maria asks czy Anna bought blouse
'Maria asks whether Anna bought a blouse.'

(44) Maria pyta, *(czy) Anna kupiła /BLUZkę czy spódNIcę\.
Maria asks czy Anna bought blouse czy skirt
'Maria asks which of a blouse or a skirt Anna bought.'

3.3.2 Question-level scope and *czy*

Now, I suggested that the embedded AQ in English (45), repeated from (26), can have either of the LFs in (46) or (47).

(45) Maria asks whether Anna bought a /BLOUSE or a SKIRT\.

(46) [whether [Anna bought a blouse]] or [~~whether~~ [~~Anna bought~~ a skirt]]

(47) [[a blouse] or [a skirt] 2[whether [Anna bought t_2]]]

The Polish facts can be seen as an instantiation of either of these patterns.

Polish and LF scoping of disjunction Let me begin with (47). Since *czy* is tied to AQ environments, one could assume that it is a special form of disjunction that is only licensed when the disjunction takes scope at the question-level. That is, the embedded AQ in (44) would have the LF in (48). The homophony between the two *czy*s would be due to them both applying at the question-level somehow.

(48) [[bluzkę] czy [spodnicę] 2[czy [Anna kupiła t_2]]]

The direct AQ in (38) above, repeated as (49), would receive a parallel LF.

(49) Anna kupiła /BLUZkę czy spódNIcę\?
Anna bought blouse czy skirt
'Which of a blouse or a skirt did Anna buy?'

In (49), the question-marker *czy* is left unpronounced. Evidence for the assumption that this question-marker is present in (49) comes from colloquial variants of Polish where the question-marker is also possible in direct questions such as (50).

(50) %Czy Anna kupiła bluzkę/?
czy Anna bought blouse
'Did Anna buy a blouse?'

Polish and disjunction of polar questions However, Polish can also be seen as being compatible with the LF in (46) where no LF scoping takes place but rather two full polar questions are directly conjoined.

One might conclude that *czy* is always a question marker and that homophony is not an accident. That is, the LF for the embedded AQ in (44) might then look as in (51) with deletion under identity and disjunction by an unpronounced *albo* taking scope at the question-level. That is, under this option *albo* would not be restricted to the proposition-level and thus to assertions and PDQs. It would just go unpronounced when applying at the question-level.

(51) [czy [Anna kupiła /BLUZkę]] ~~albo~~ [czy [~~Anna kupiła~~ spódNIcę\ ]]

Under this second type of LF, there is an unpronounced additional *czy* in the direct AQ in (49) as in (52). (50) was said to provide support for this. Why this first *czy* but not the second one can be elided is an issue to which I do not have an answer.

(52) [~~czy~~ [Anna kupiła /BLUZkę]] ~~albo~~ [czy [~~Anna kupiła~~ spódNIcę\ ]]

Evaluating the options for Polish Can we distinguish between the two options discussed for Polish AQs? In particular, is it possible to lend some further credence to the second option, which might seem more ad hoc than the first one even though it might be preferable given its avoidance of lexical ambiguity for *czy*?

First, it is marginally possible for *albo* and *czy* to co-occur next to each other if the material in the disjoined polar questions is made maximally contrastive, as in (53). Note that due to the fact that the matrix subject denotes the speaker, the disjunction must be embedded under *pytam* ('I ask'). Otherwise (53) would have the non-sensical meaning that the speaker does not know what she is asking.[11]

(53) ?Pytam, czy /ANna kupiła BLUZkę albo czy MAria kupiła spódNIcę\.
ask czy Anna bought blouse albo czy Maria bought skirt
'I ask which of Anna buying a blouse or Maria buying a skirt is true.'

[11] While (53) is somewhat marginal, it is distinctly better than (i) where *czy* is left out. Due to the combination of the embedding predicate and the final fall intonation, the embedded clause in (i) can only be interpreted as an AQ. For that interpretation, however, *czy* would have to be present.

(i) *Pytam, czy /ANna kupiła BLUZkę albo MAria kupiła spódNIcę\.
ask czy Anna bought blouse albo Maria bought skirt

The representational option for Polish AQs in (48) with LF scoping does not straightforwardly account for the possibility of (53). There *czy* functions as disjunction. Consequently the presence of ***albo*** is unexpected. The second type of LF has no problem with (53). Again, I leave open the issue why ***albo*** is marginal here.

Second, Polish has what is termed coordination of non-constituents as in (54). As discussed for English (30), this might be evidence for non-constituent ellipsis:

(54) Anna kupiła bluzkę w czwartek i spódnicę w piatek.
Anna bought blouse on Thursday and skirt on Friday
'Anna bought a blouse on Thursday and a skirt on Friday.'

Interestingly, it is possible to have non-constituent coordination with AQs where one of the constituents in each apparent coordinate is in an island: the constituents ***Einsteina*** and ***Wittgensteina*** in (55) are in a reduced relative clause with a prepositional phrase. That reduced relative clauses with prepositional phrases are islands can be seen by the ungrammaticality of overt movement from them as in (56).[12]

(55) (Czy) Anna potwierdziła teorie głoszone przez /EinSTEIna w
czy Anna confirmed theories held by Einstein on
CZWARtek czy przez WittgenSTEIna w PIĄtek\?
Thursday czy (by) Wittgenstein on Friday
'Did Anna confirm theories held by Einstein on Thursday, or did she confirm theories held by Wittgenstein on Friday?'

(56) *Kogo Anna potwierdziła teorie głoszone przez w piątek?
who Anna confirmed theories held by on Friday

On the present hypothesis disjunction in AQs must have clause-level scope. If LF scoping is subject to islands, the only way to achieve this in (55) is by ellipsis of non-constituents (see von Stechow (1996) for arguments against LF pied-piping). But then representations like (51) and (52) above might not be so problematic.

I must leave the question of which LF is the correct one for AQs open for future research. It is clear that the disjunction of full polar questions is necessary to account for (53). In addition, the option with LF scoping is quite possibly available as well. What is crucial to note, however, is that under either analysis Polish AQs support the hypothesis from (34a) that an AQ interpretation correlates with question-level disjunction. Under any other analysis it would be hard to see how one could account for the restriction of *czy* to AQ environments.

Finally, if final rise and final fall intonation somehow correlate with the scope of disjunction, it immediately follows that *czy* cannot be combined with a final rise, as evidenced by (40) above.

3.4 The explanatory challenge raised by disjunctions of questions

I put forward the hypothesis that question-level scope of disjunction should be considered a prerequisite for an AQ-interpretation to obtain (following Karttunen 1977, Haida 2013, Nicolae 2013, Pruitt and Roelofsen 2011, Uegaki 2014 a.o.).

[12] I thank Adam Szczegielniak (p.c.) for help with and discussion of these examples. See also Bruening (2015) for discussion of non-constituent coordination with reduced relative clauses in English.

Now we have seen that Polish supports this view.

So the following picture emerges: as seen in section 2.2, AQs but not PDQs exhibit the exactly-one meaning component. The present section moreover argued that AQs and PDQs differ representationally. It is therefore desirable to derive both the denotational differences between AQs and PDQs — something along the lines of section 2.3 — and the exactly-one component of AQs from this, as a compositional by-product as it were. I take this to be the explanatory challenge:

(57) *The explanatory challenge raised by the disjunctive question hypothesis*
The hypothesized scope difference between AQs and PDQs is to be implicated in the explanation of their observed interpretative differences.

4 The core of the proposal

I will now present a novel analysis of AQs which meets the explanatory challenge in (57). I use the English example in (58) with disjunction of full polar questions.

(58) Did John bring the /BEER, or did he bring the WINE\?

I present the proposal by assuming the representation in (59) for (58) where *whether* is an instance of Karttunen's 1977 question operator.

(59) [? [John brought the beer]] or [? [John brought the wine]]

I return to LF scoping of disjunction in section 4.4 and show its compatibility with the proposal. In PDQs disjunction takes scope below the question operator. This yields a denotation difference between AQs and PDQs as discussed in section 2.3.

The analysis consists of three crucial ingredients apart from question-level scope of disjunction. First, the pitch accents in AQs are interpreted as mutually exclusive foci (see Nicolae 2013, but also Han and Romero 2004a). Second, Karttunen's question operator is modified to contribute a presupposition. And third, it is shown that by adopting the three-valued Strong Kleene semantics all of this conspires to derive the exactly-one meaning component from independently motivated assumptions about presupposition projection from disjunctions. That is, both the denotational difference between AQs and PDQs and the exactly-one component of AQs are ultimately the result of the difference in mutual scope of disjunction and question operator, addressing the explanatory challenge in (57).

Since the account is couched in a trivalent semantics — where the third value # counts as a truth-value — a function from some domain into truth-values is always a total function. Thus I will exhaustively specify for such a function which truth-value it returns under which circumstance. A function into truth-values looks schematically as in (60). It takes an argument χ of type τ and returns that truth-value, one of {1, 0, #}, whose condition after the *if* is satisfied.[13]

[13] In other words, (60) is short for:

(i) $f : D_\tau \rightarrow \{1, 0, \#\}$
For all $\chi \in D_\tau$, $f(\chi) = 1$ if α, $f(\chi) = 0$ if β, and $f(\chi) = \#$ if γ.

(60) $\lambda\chi_\tau.\begin{cases}1 \text{ if } \alpha\\ 0 \text{ if } \beta\\ \# \text{ if } \gamma\end{cases}$

4.1 Exhaustive focus

The first component of the proposal is that the pitch accents in the AQ in (58) are analyzed as contributing mutually exclusive and thereby exhaustive foci. The LF in (59) is updated as in (61).

(61) [? [Exh_C [J brought the beer_F]]] or [? [Exh_D [J brought the wine_F]]]

Subscript F in (61) stands for F-marking, and Exh is the exhaustivity operator. I discuss the semantic contribution of each in turn.

For concreteness I adopt Rooth's 1985 theory of focus interpretation. In that theory, the role of focus is to make alternative meanings available. So there are two interpretation values for each constituent α: the ordinary value of α, $[\![\alpha]\!]^g$, and the focus value of α, $[\![\alpha]\!]^{g,f}$. Whereas $[\![\alpha]\!]^g$ constitutes the standard denotation of α and always ignores F-marks, $[\![\alpha]\!]^{g,f}$ corresponds to a set of denotations of the same type as $[\![\alpha]\!]^g$. In case there is no F-mark on α and α is non-complex, $[\![\alpha]\!]^{g,f}$ is the singleton containing only the ordinary value of α. If there is an F-mark on α and α is non-complex, $[\![\alpha_F]\!]^{g,f}$ is the set of alternative denotations of the same type as $[\![\alpha]\!]^g$. Focus values combine by point-wise functional application. This means that if α consists of β and γ, $[\![\alpha]\!]^{g,f}$ corresponds to the set where each of the alternative denotations in $[\![\gamma]\!]^{g,f}$ is applied to each of the alternative denotations in $[\![\beta]\!]^{g,f}$.[14]

This means that the focus values of the constituents embedded under the exhaustivity operators in (61) are identical given that their sub-constituents are identical except for the *beer*- and *wine*-parts and that these differences are made superfluous due to the presence of F-marks on each of them:

(62) $[\![\textbf{John brought the beer}_F]\!]^{g,f} = [\![\textbf{John brought the wine}_F]\!]^{g,f}$
$= \{\lambda w.\,\text{John brought } x \text{ in } w \mid x \in D_e\}$

[14] More formally, the compositional rules for focus values are as follows:

(i) *Ordinary values for non-complex constituents*
a. $[\![\alpha]\!]^g = [\![\alpha]\!]^o$ if the denotation of α is specified in the lexicon, $g(\alpha)$ otherwise,
b. $[\![\alpha_F]\!]^g = [\![\alpha]\!]^g$.

(ii) *Ordinary values for complex constituents*
If α consists of β and γ and $[\![\beta]\!]^g \in dom([\![\gamma]\!]^g)$, $[\![\alpha]\!]^g = [\![\gamma]\!]^g([\![\beta]\!]^g)$.

(iii) *Focus values for non-complex constituents*
For $[\![\alpha]\!]^g \in D_\tau$,
a. $[\![\alpha]\!]^{g,f} = [\![\alpha]\!]^g$,
b. $[\![\alpha_F]\!]^{g,f} = \{x : x \in D_\tau\}$.

(iv) *Focus values for complex constituents*
If α consists of β and γ and $[\![\beta]\!]^g \in dom([\![\gamma]\!]^g)$, $[\![\alpha]\!]^{g,f} = \{x : \exists y \in [\![\beta]\!]^{g,f}.\exists h \in [\![\gamma]\!]^{g,f}.\ x = h(y)\}$.

The exhaustivity operator Exh (Groenendijk and Stokhof 1984, Krifka 1995, van Rooij and Schulz 2004, Fox 2007, Spector 2007, Chierchia et al. 2012) directly associates with focus. It does so by including the semantic contribution of Rooth's 1992 squiggle-operator. That is, Exh bears the variable C receiving the value of a set of alternatives via the assignment function g. Exh requires that its set of alternatives C is a subset of the focus value of its prejacent. Exh also requires that the prejacent and its alternatives do not receive the third value (Spector and Sudo 2014). Finally, the resulting function returns 1 if the prejacent of Exh is 1 and all non-weaker alternatives are false. In the following $\Rightarrow$ stands for *entails*.[15]

(63) $$[\![\mathbf{Exh}_C\ \phi]\!]^g = \lambda w_s.\begin{cases} 1 \text{ if } g(C) \subseteq [\![\phi]\!]^{g,f} \text{ and } [\![\phi]\!]^g(w) = 1 \text{ and} \\ \quad \forall q \in g(C)[[[\![\phi]\!]^g \not\Rightarrow q] \rightarrow q(w) = 0] \\ 0 \text{ if } g(C) \subseteq [\![\phi]\!]^{g,f} \text{ and } [[\![\phi]\!]^g(w) = 0 \text{ or } \exists q \in g(C) \\ \quad [[\![\phi]\!]^g \not\Rightarrow q \wedge q(w) = 1]] \text{ and } \forall q \in g(C).q(w) \neq \# \\ \# \text{ if } g(C) \not\subseteq [\![\phi]\!]^{g,f} \text{ or } [\![\phi]\!]^g(w) = \# \text{ or } \exists q \in g(C).q(w) = \# \end{cases}$$

Note that given the equivalence of the focus values in (62), the alternatives for the exhaustivity operators are also equivalent. In the following, I assume that the context determines that the two prejacents constitute the alternatives: {*that John brought the beer*, *that John brought the wine*}.[16] Notice that these propositions are logically independent. For each disjunct in (61) Exh thus negates the alternative different from its own prejacent and conjoins it with the latter. The resulting denotations ignoring the conditions for 0 and # are as in (64).[17]

(64) a. $[\![\mathbf{Exh}_C\ [\mathbf{John\ brought\ the\ beer}_F\ ]]\!]^g =$
$\lambda w.$ John brought the beer and not the wine in w

b. $[\![\mathbf{Exh}_D\ [\mathbf{John\ brought\ the\ wine}_F\ ]]\!]^g =$
$\lambda w.$ John brought the wine and not the beer in w

In other words, the contribution of an F-mark in a disjunct of an AQ is to exclude the alternative provided by the respective other disjunct. I will now turn to the semantic contribution of the question operator and the pragmatics of questions. Both will turn out to be crucial when combined with the results from this section.

[15] The notion of entailment relevant for a trivalent setting is as in (i) (Spector and Sudo 2014).

(i) p entails q, $p \Rightarrow q$, iff $\forall w[p(w) = 1 \rightarrow q(w) = 1]$.

[16] This leaves open the possibility that in particular contexts more alternatives than these get excluded (Biezma and Rawlins 2012). If the relevant alternatives were determined anaphorically (Rooth 1992), this would not be an option. It must also be noted that the entry for Exh given is a simplification. The fully accurate entry only makes reference to a particular subset of the contextually available alternatives (Fox 2007). This simplification is harmless for our immediate purposes.

[17] The trivalent denotation of (64a) is as in (i). A parallel denotation obtains for (64b).

(i) $$\lambda w.\begin{cases} 1 \text{ if John brought beer and not wine in } w \text{ and } g(C) \subseteq [\![\mathbf{John\ brought\ the\ beer}]\!]^{g,f} \\ 0 \text{ if } \neg(\text{John brought beer and not wine in } w) \text{ and } g(C) \subseteq [\![\mathbf{John\ brought\ the\ beer}]\!]^{g,f} \\ \quad \text{and } [\![\mathbf{John\ brought\ the\ wine}]\!]^g(w) \neq \# \\ \# \text{ if } g(C) \not\subseteq [\![\mathbf{John\ brought\ the\ beer}]\!]^{g,f} \text{ or } [\![\mathbf{John\ brought\ the\ beer}]\!]^g(w) = \# \text{ or} \\ \quad [\![\mathbf{John\ brought\ the\ wine}]\!]^g(w) = \# \end{cases}$$

4.2 A presuppositional semantics for questions

4.2.1 A trivalent question operator

I now adapt Karttunen's 1977 general question operator to a trivalent semantics by making it presuppositional, as in (65). ? in (65) when applied to a proposition $[\![\phi]\!]^g$ and a world w denotes the three-valued function from propositions p to truth-values that returns 1 in case p is $[\![\phi]\!]^g$ and 1 in w, 0 in case p is $[\![\phi]\!]^g$ and 0 in w, and the third value # in case p is any other proposition or p itself receives # in w.

(65) $$[\![\textbf{?}\ \phi]\!]^g = \lambda w_s.\lambda p_{st}.\begin{cases} 1 \text{ if } p = [\![\phi]\!]^g \wedge p(w) = 1 \\ 0 \text{ if } p = [\![\phi]\!]^g \wedge p(w) = 0 \\ \# \text{ if } p \neq [\![\phi]\!]^g \vee p(w) = \# \end{cases}$$

So the denotation of the polar question in (66) under the LF in (67a) in world w is (67b). (67b) gives a truth-value other than the third value only in case it is applied to the proposition *that John brought the beer* and this proposition is either 1 or 0.

(66) Did John bring the beer?

(67) a. [? [John brought the beer]]

b. $$[\![\textbf{(67a)}]\!]^g(w) = \lambda p.\begin{cases} 1 \text{ if } p = \lambda w'.\text{J brought the beer in } w' \wedge p(w) = 1 \\ 0 \text{ if } p = \lambda w'.\text{J brought the beer in } w' \wedge p(w) = 0 \\ \# \text{ if } p \neq \lambda w'.\text{J brought the beer in } w' \vee p(w) = \# \end{cases}$$

While this is close to Karttunen's 1977 semantics, it also differs in crucial respects from it. Consider (66) in a world where John did not bring the beer and does not smoke. Karttunen's denotation for (66) would map both the proposition *that John brought the beer* and *that John smokes* to 0 in that world. (67b), however, makes a crucial difference between the two propositions. The former is mapped to 0, and the latter to #. In other words, unlike Karttunen's account the present view allows one to reconstruct from the truth-value that a proposition is mapped onto by a question denotation in a given world whether or not the question is, in an intuitive sense, about that proposition or not.

On a slightly more general level, the intuition behind this is that a polar question when applied to a world raises an issue. The issue is whether a given proposition is 1 or 0 in that world. Which proposition this is, is determined by the overt linguistic material under the question operator and becomes a presupposition of the question denotation. At least in the most basic case — that of polar questions — the truth-values 1 and 0 then only obtain if the proposition fed to the question denotation in a world solves the issue raised by the question. In other words, given the truth-value 1 or 0 we know what is the case in that world. I think this is desirable and a possible advantage over Karttunen's account.[18]

[18] Other than the yes-no question operator discussed in (18) above, the general one used in the text cannot map the negation of its argument proposition to 1. See sections 5.3.1 and 5.4.1 for how negative answers can be implemented in the present setting. See Bolinger (1978), Büring (2003), Biezma and Rawlins (2012), Uegaki (2014) for further arguments that this is desirable.

4.2.2 Question speech acts

How are trivalent question denotations as just discussed used in order to perform a question speech act? I suggest that a speaker uttering an interrogative with such a denotation requests for information as in (68) (e.g. Heim 2000) with the ancillary notions of possible and true direct answers as in (69) (e.g. von Fintel and Heim 2001). Given what was just said, a direct answer to a polar question intuitively corresponds to the proposition whose truth-value is the issue raised by the question, i.e., the proposition that can be mapped to a value other than #. From now on, lower case Greek letters indicate propositions, and upper case ones questions.[19]

(68) *Question speech act*
A speaker uttering in world w Φ where $[\![\Phi]\!]^g \in D_{\langle s,\langle st,t\rangle\rangle}$ requests to be told the possible direct answers to Φ that are true direct answers to Φ in w.

(69) *Possible and true direct answers*
Given ϕ and Φ where $[\![\phi]\!]^g \in D_{st}$ and $[\![\Phi]\!]^g \in D_{\langle s,\langle st,t\rangle\rangle}$, the set of possible worlds W, and world w,

a. ϕ is a possible direct answer to Φ iff $\exists w' \in W : [\![\Phi]\!]^g(w')([\![\phi]\!]^g) \neq \#$.
b. ϕ is a true direct answer to Φ in w iff ϕ is a possible direct answer to Φ and $[\![\phi]\!]^g(w) = 1$.

In order to see what (68) does, consider the question in (70), which has the denotation in (71) when uttered in world w. According to (69), *that John met the king of France* is one and in fact the only possible direct answer to (70).

(70) Did John meet the king of France?

(71) $$[\![\textbf{(70)}]\!]^g(w) = \lambda p.\begin{cases} 1 \text{ if } p = \lambda w'.\text{ J met the king of France in } w' \wedge p(w) = 1 \\ 0 \text{ if } p = \lambda w'.\text{ J met the king of France in } w' \wedge p(w) = 0 \\ \# \text{ if } p \neq \lambda w'.\text{ J met the king of France in } w' \vee p(w) = \# \end{cases}$$

Given (68) and the notion of possible answer, the speaker of (70) wants to be told whether *that John met the king of France* is 1 in w. Imagine there is no king of France in w. Then the proposition *that John met the king of France* will simply not be mapped to 1 by (71). Consequently given (68) the speaker will not request to be told about its truth-value. From not being told about its truth-value, however, the speaker will not have learned much as the situation would be compatible with either there not being a king of France or there being one but John not having met him. This is in conflict with our intuitions. Intuitively, the speaker of (70) does seem to take for granted that there is a king of France. The complication, of course, arises from the fact that *the king of France* is presuppositional. Let me therefore turn to the issue of how speaker presuppositions are determined in a trivalent semantics.

[19] A reviewer notes that one might like to have a general notion of *utterance* unifying both assertive and question speech acts. Also other notions of answerhood can be defined on the basis of a direct answer. See section 4.2.4.

4.2.3 Determining the presupposition in a trivalent semantics

As noted in the literature on presupposition projection from assertions in a trivalent semantics, an additional assumption is necessary in order to derive the presuppositions of an utterance. Following Stalnaker (1974), one adopts an assertability condition that provides the bridge between compositional semantics and the pragmatics of assertion. This condition essentially states that a speaker can only make an assertion if all worlds in the context set c are such that they make the assertion either 1 or 0, i.e., they do not yield the third value $\#$ (Beaver and Krahmer 2001, Fox 2008, 2013). This means that a speaker asserting a proposition takes it for granted that the proposition has a truth-value other than $\#$. The idea here is that a speaker should not assert a proposition for which he thinks it possible that it is neither true nor false.

(72) *Assertability condition on assertions*
ϕ where $[\![\phi]\!]^g \in D_{st}$ is assertable in context c only if $\forall w \in c : [\![\phi]\!]^g(w) \neq \#$.

The truth-conditions of a sentence together with the assertability condition derive the presupposition of the sentence. Generally speaking, for any assertion its presupposition corresponds to what it takes for the assertion to not receive the third value $\#$. For instance, assuming that (73) has the truth-conditions in (74), the assertability condition in (72) tells us that (73) presupposes that John has a unique sister. This is what it takes for the sentence to receive a truth-value other than $\#$.

(73) John met his sister.

(74) $[\![\textbf{(73)}]\!]^g = \lambda w.$ $\begin{cases} 1 \text{ if John has a unique sister in } w \text{ and he met her in } w \\ 0 \text{ if John has a unique sister in } w \text{ and did not meet her in } w \\ \# \text{ if John does not have a unique sister in } w \end{cases}$

One can state similar conditions on speech-acts other than assertions. And in fact on Stalnaker's picture one must do so. Recall that (72) amounts to the requirement that the speaker believe that the asserted proposition does not receive the third value $\#$ because one should not assert propositions that are neither true nor false. It seems natural to require something similar of a condition on askability. In particular, such a condition should guarantee that the speaker of a question take it for granted that the issue raised by the question can be settled and therefore prevent speakers from uttering questions whose issues might be unsolvable. Now recall that the issue of a polar question is whether the proposition embedded under the question operator is 1 or 0. When can the issue raised by such a question not be settled? In case the proposition embedded by the question operator receives the truth-value $\#$, i.e., when it is neither true nor false. Arguably, this intuition extends the reasoning behind the assertability condition to question speech acts.

To cash out this intuition formally, the condition in (75) requires that for a question to be askable at all, for each world in the context set c there must be a proposition such that when the question is applied to both, either 1 or 0 is returned. In other words, a speaker should not raise a polar question whose possible direct answer might be neither true nor false.

(75) *Askability condition on questions*

Φ where $[\![\Phi]\!]^g \in D_{\langle s,\langle st,t\rangle\rangle}$ is askable in context c only if $\forall w \in c.\exists p : [\![\Phi]\!]^g(w)(p) \neq \#$.

Consider again (76) with its denotation in (77). According to (75), when (76) is uttered in world w some proposition must be mapped to 1 or 0 by (77) in w. This is only the case if that proposition is *that John met the king of France* and it does not receive # in w. Thus the speaker of (76) presupposes by (75) that the proposition *that John met the king of France* and no other one is mapped to either 1 or 0 by (77). This means, he takes for granted two things: first that the issue whether John met the king of France can be settled, and second that there is a king of France.

(76) Did John meet the king of France?

(77) $[\![\textbf{(76)}]\!]^g(w) = \lambda p.\begin{cases} 1 \text{ if } p = \lambda w'.\text{ J met the king of France in } w' \wedge p(w) = 1 \\ 0 \text{ if } p = \lambda w'.\text{ J met the king of France in } w' \wedge p(w) = 0 \\ \# \text{ if } p \neq \lambda w'.\text{ J met the king of France in } w' \vee p(w) = \# \end{cases}$

The combination of the definition of question speech act and the askability condition determines what it means for a speaker to ask a question in a trivalent system.

4.2.4 True exhaustive answer

Under which conditions can (76), be said to be answered? Recall that in any world in which there is a king of France, the proposition *that John met the king of France* is a and in fact the direct answer to (76). If moreover John indeed met the king of France, *that John met the king of France* is also a true direct answer.

While truth is a property intuitively associated with answers, the notion of a true direct answer will not suffice in the general case. For instance, if there is a king of France in w and John did not meet him, there simply is no true direct answer in w. A more general notion of answerhood can be defined as in (78) following Groenendijk and Stokhof (1984). (78) says that a sentence is a true exhaustive answer to a question in world w if and only if it (contextually) entails the proposition stating that the set of true direct answers to the question is what it is in w.

(78) *True exhaustive answer*
ϕ is a true exhaustive answer to Φ in w where $[\![\phi]\!]^g \in D_{st}$ and $[\![\Phi]\!]^g \in D_{\langle s,\langle st,t\rangle\rangle}$ iff $[\![\phi]\!]^g \Rightarrow_c \lambda w'.\{p : [\![\Phi]\!]^g(w)(p) = 1\} = \{p : [\![\Phi]\!]^g(w')(p) = 1\}$

If John met the king of France in w, a true exhaustive answer to (76) in w must (contextually) entail the proposition saying that the set of true direct answers is identical to the set containing just the proposition *that John met the king of France.* This seems adequate as it entails that John met the king of France. If, on the other hand, w is such that there is a king of France in it and John did not meet him, then a true exhaustive answer to (76) in w must entail that the set of true direct answers to (76) is the empty set. Does it follow from such a proposition that John did not meet the king of France in w? Only if it is presupposed that there is a king of France. After all the set of true direct answers could also be empty in virtue of there not existing a king of France. Luckily, this situation is ruled out by the

askability condition. Given that the speaker of (76) presupposes that there is a king of France, a cooperative interlocutor providing an answer entailing that the set of true direct answers to (76) is empty is assumed to share that presupposition. Otherwise, he should say so. Finally, further notions of answer could be necessary.

4.3 Disjunction in a Strong Kleene semantics

Returning to the AQ from (58) and its LF from (61), repeated in (79) and (80) respectively, we can now determine the denotations of the disjuncts.

(79) Did John bring the /BEER, or did he bring the WINE\?

(80) [? [Exh_C [J brought the beer_F]]] or [? [Exh_D [J brought the wine_F]]]

Given that I proposed to analyze the pitch accents as mutually exclusive foci, and given the conclusions about the denotations of the constituents embedded under the question operators in (80) reached in (64), the disjuncts in (80) have the following trivalent denotations:

(81) $[\![\textbf{? [Exh}_C \textbf{ [John brought the beer}_F \textbf{]]}]\!]^g =$

$$\lambda w.\lambda p.\begin{cases} 1 \text{ if } p = \lambda w'.\,\text{J brought beer and not wine in } w' \wedge p(w) = 1 \\ 0 \text{ if } p = \lambda w'.\,\text{J brought beer and not wine in } w' \wedge p(w) = 0 \\ \# \text{ if } p \neq \lambda w'.\,\text{J brought beer and not wine in } w' \vee p(w) = \# \end{cases}$$

(82) $[\![\textbf{? [Exh}_D \textbf{ [John brought the wine}_F \textbf{]]}]\!]^g =$

$$\lambda w.\lambda p.\begin{cases} 1 \text{ if } p = \lambda w'.\,\text{J brought wine and not beer in } w' \wedge p(w) = 1 \\ 0 \text{ if } p = \lambda w'.\,\text{J brought wine and not beer in } w' \wedge p(w) = 0 \\ \# \text{ if } p \neq \lambda w'.\,\text{J brought wine and not beer in } w' \vee p(w) = \# \end{cases}$$

Assuming with Partee and Rooth (1983) a cross-categorial semantics for coordination, it follows that one should be able to apply disjunction to these polar questions. The result should again be a function from propositions to truth-values. That is, (79) should denote a question. But which function is that?

4.3.1 Strong Kleene semantics and presupposition projection

What is the presupposition of (79)? Given that it conforms to a disjunction of polar questions, this is tantamount to asking how the presuppositions of the polar questions project through disjunction. At this point it becomes crucial which semantic entry one assumes for disjunction. More precisely, we need to decide under which conditions a disjunction inherits the third value from one of its disjuncts.

Again, in the literature on presupposition projection in assertions it has been pointed out that the truth-tables for connectives associated with Strong Kleene semantics achieve largely adequate results (see Peters 1979, Chierchia 1995, Fox 2008, 2013, George 2008, 2010 a.o.).[20] Here it helps to think of the third value $\#$ as meaning that the "actual" truth-value is undecided between 1 and 0. The idea

[20] It must be pointed out, though, that another ingredient is necessary to derive effects of linear order on presupposition projection. Fox (2008) shows that an incremental version of a Strong Kleene system can be built using Schlenker's 2008 quantification over so-called good finals.

behind a Strong Kleene system is then that if a bivalent semantics, which does not know of a third value #, could nevertheless assign either 1 or 0 to a complex constituent, then that value is assigned. The third value is only assigned in those situations in which a bivalent system could not decide between 1 and 0.

This method yields the truth-table for disjunction in (83). A disjunction receives the value 1 as soon as one of its disjuncts is 1. It does not matter if the other disjunct has the value 0 or #. This is so because also in a bivalent system a disjunction is 1 as soon as one of the disjuncts is 1. On the other hand, if one disjunct is 0 or #, an undecided value # for the other disjunct does matter. In this case a bivalent system could not decide between 1 and 0 for the whole disjunction. In other words, if one disjunct bears a value other than 1, the third value of the other disjunct matters, and as a consequence the whole disjunction inherits the third value.

(83)

∨	1	0	#
1	1	1	1
0	1	0	#
#	1	#	#

From the truth-table in (83), a cross-categorial definition for disjunction can be given. Following Partee and Rooth (1983:363f.), we start by defining a recursive notion of conjoinable type as in (84).

(84) a. t is a conjoinable type.
b. If τ is a conjoinable type, then for all σ, $\langle\sigma,\tau\rangle$ is a conjoinable type.

From this, we define the cross-categorial entry for *or* in (85a). In the case where the expressions to be disjoined are truth-values, the resulting truth-value is read off the truth-table in (83), as defined in (85b). The disjunction of conjoinable expressions other than truth-values reursively reduces to this basic case as defined in (85c).

(85) a. $[\![\textbf{A [or B]}]\!]^g = [\![\textbf{A}]\!]^g \sqcup [\![\textbf{B}]\!]^g$
b. If $[\![\textbf{A}]\!]^g, [\![\textbf{B}]\!]^g \in D_t$,

$$[\![\textbf{A}]\!]^g \sqcup [\![\textbf{B}]\!]^g = \begin{cases} 1 \text{ if } \exists t \in \{[\![\textbf{A}]\!]^g, [\![\textbf{B}]\!]^g\} : t = 1 \\ 0 \text{ if } [\![\textbf{A}]\!]^g = [\![\textbf{B}]\!]^g = 0 \\ \# \text{ if } [[\![\textbf{A}]\!]^g = \# \wedge [\![\textbf{B}]\!]^g \neq 1] \vee [[\![\textbf{B}]\!]^g = \# \wedge [\![\textbf{A}]\!]^g \neq 1] \end{cases}$$

c. If $[\![\textbf{A}]\!]^g, [\![\textbf{B}]\!]^g \in D_{\langle\sigma,\tau\rangle}$, $[\![\textbf{A}]\!]^g \sqcup [\![\textbf{B}]\!]^g = \lambda\chi_\sigma.[\![\textbf{A}]\!]^g(\chi) \sqcup [\![\textbf{B}]\!]^g(\chi)$

While I refer to proposition-level disjunction as or_p and to question-level disjunction as or_q in the following, it should be kept in mind that they are really one and the same lexical item in (85). Now, with or_p the recursive step (85c) applies once, resulting in (86).

(86) $[\![\phi \textbf{ [or}_p\ \psi \textbf{]}]\!]^g = \lambda w_s.[\![\phi]\!]^g(w) \sqcup [\![\psi]\!]^g(w)$

$$= \lambda w_s. \begin{cases} 1 \text{ if } \exists t \in \{[\![\phi]\!]^g(w), [\![\psi]\!]^g(w)\} : t = 1 \\ 0 \text{ if } [\![\phi]\!]^g(w) = [\![\psi]\!]^g(w) = 0 \\ \# \text{ if } [[\![\phi]\!]^g(w) = \# \wedge [\![\psi]\!]^g(w) \neq 1] \vee \\ \qquad [[\![\psi]\!]^g(w) = \# \wedge [\![\phi]\!]^g(w) \neq 1] \end{cases}$$

With (86) and the assertability condition on assertions, (87) receives the truth-conditions in (88) and the conditional presupposition that if John didn't stay home, he has a sister. This seems unobjectionable.[21]

(87) John met his sister, or he stayed home.

(88) $[\![\textbf{(87)}]\!]^g =$

$$\lambda w.\begin{cases} 1 \text{ if } \exists t \in \{[\![\textbf{John met his sister}]\!]^g(w), [\![\textbf{he stayed home}]\!]^g(w)\} : t = 1 \\ 0 \text{ if } [\![\textbf{John met his sister}]\!]^g(w) = [\![\textbf{he stayed home}]\!]^g(w) = 0 \\ \# \text{ if } [[\![\textbf{John met his sister}]\!]^g(w) = \# \wedge [\![\textbf{he stayed home}]\!]^g(w) \neq 1] \vee \\ \quad [[\![\textbf{he stayed home}]\!]^g(w) = \# \wedge [\![\textbf{John met his sister}]\!]^g(w) \neq 1] \end{cases}$$

I now apply this reasoning to AQs and show that it gives the desired result.

4.3.2 Deriving the exactly-one meaning component

In the case of or_q the recursive step (85c) is applied twice resulting in (89). Twice because $[\![\Phi]\!]^g$ and $[\![\Psi]\!]^g$ are of the complex type $\langle s, \langle st, t\rangle\rangle$. The disjunction in (89) disjoins two questions and returns another question. The resulting question maps a proposition p and a world w to 1 if one of the former two questions maps p and w to 1 and to 0 if both of them map p and w to 0. Finally, the third value # obtains if one of the disjuncts maps p and w to # and the other one to 0 or #.

(89)
$$\begin{aligned} [\![\Phi \textbf{ [or}_q\ \Psi \textbf{]}]\!]^g &= \lambda w_s.[\![\Phi]\!]^g(w) \sqcup [\![\Psi]\!]^g(w) \\ &= \lambda w_s.\lambda p_{st}.[\![\Phi]\!]^g(w)(p) \sqcup [\![\Psi]\!]^g(w)(p) \\ &= \lambda w_s.\lambda p_{st}.\begin{cases} 1 \text{ if } \exists t \in \{[\![\Phi]\!]^g(w)(p), [\![\Psi]\!]^g(w)(p)\} : t = 1 \\ 0 \text{ if } [\![\Phi]\!]^g(w)(p) = [\![\Psi]\!]^g(w)(p) = 0 \\ \# \text{ if } [[\![\Phi]\!]^g(w)(p) = \# \wedge [\![\Psi]\!]^g(w)(p) \neq 1] \vee \\ \quad [[\![\Psi]\!]^g(w)(p) = \# \wedge [\![\Phi]\!]^g(w)(p) \neq 1] \end{cases} \end{aligned}$$

Recall once more the AQ from (79), repeated in (90). Given the denotations of its two embedded polar questions — determined in (81) and (82) above — (89) yields (91) as its denotation.

(90) Did John bring the /BEER, or did he bring the WINE\?

(91) $[\![\textbf{(90)}]\!]^g =$

$$[\![\textbf{or}_q]\!]^g \left(\lambda w.\lambda p.\begin{cases} 1 \text{ if } p = \lambda w'.\text{J brought beer and not wine in } w' \wedge p(w) = 1 \\ 0 \text{ if } p = \lambda w'.\text{J brought beer and not wine in } w' \wedge p(w) = 0 \\ \# \text{ if } p \neq \lambda w'.\text{J brought beer and not wine in } w' \vee p(w) = \# \end{cases} \right)$$

$$\left(\lambda w.\lambda p.\begin{cases} 1 \text{ if } p = \lambda w'.\text{J brought wine and not beer in } w' \wedge p(w) = 1 \\ 0 \text{ if } p = \lambda w'.\text{J brought wine and not beer in } w' \wedge p(w) = 0 \\ \# \text{ if } p \neq \lambda w'.\text{J brought wine and not beer in } w' \vee p(w) = \# \end{cases} \right)$$

[21] Unobjectionable insofar as the prediction corresponds to the one of dynamic semantics (Beaver 2001, Schlenker 2009). Now, it seems that normally (87) has the stronger inference that John has a sister. This issue is known as the proviso problem (Geurts 1996). A number of proposals are found in the literature to strengthen the predicted conditional presupposition (e.g. Singh 2007, Schlenker 2011, Lassiter 2012, Mayr and Romoli to appear a.o.), which could be adopted here as well.

(91) corresponds to a trivalent version of one of the intuitively plausible denotations for AQs discussed in section 2.3, namely (21). On the one hand, (91) maps a proposition p to 1 in w if one of the embedded questions — i.e., one of the disjuncts — does. Now, the first disjunct maps p to 1 only if p is the proposition *that John brought the beer and not the wine* and that proposition is moreover 1 in w. The second disjunct maps p to 1 only if p is the proposition *that John brought the wine and not the beer* and that proposition is 1 in w. On the other hand, (91) maps a proposition p to 0 in w if both of the disjuncts do. A necessary condition for this is that p is both equivalent to the proposition *that John brought the beer and not the wine* and the proposition *that John brought the wine and not the beer.* However, nothing can be equivalent to both of these propositions.

What are the consequences of this for the presuppositions of (91)? The askability condition allows a question to be uttered only in case it maps a proposition to 1 or 0 in each world in the context set. So we need to ask what a world w has to be like so that (91) does not return # in w. The only propositions that stand a chance of being mapped to a value different from # by (91) are *that John brought the beer and not the wine* and *that John brought the wine and not the beer.* Notice also, that for each of these it holds that one embedded polar question will return # when applied to them, given the equivalence requirement contributed by the question operator regardless of the world considered.

First, consider what happens in a world in which John brought neither wine nor beer. Each proposition mentioned above is 0 in such a world. Thus each is mapped to 0 by one embedded question and to # by the other one. For example, the proposition *that John brought the beer and not the wine* is mapped to 0 by the first polar question in (91) and to # by the second one. The reverse holds for the proposition *that John brought the wine and not the beer.* As a consequence, (91) returns # for both propositions in such a world. Since no other proposition stands a chance of being mapped to 1 or 0, (91) cannot be asked in a world where John brought neither beer nor wine according to the askability condition.

Consider next a world where John brought both wine and beer. The same situation as before obtains. Both relevant propositions are 0 in such a world. Thus each is mapped to 0 by one of the embedded questions and to # by the respective other one. Again because of disjunction, (91) maps the only propositions that could receive 1 or 0 to # in such a world. The askability condition again prohibits the question from being asked in a world where John brought both beer and wine.

Finally in a world in which John brought wine but not beer, the proposition *that John brought the wine and not the beer* is 1. Thus one embedded polar question returns 1 for the proposition. By the definition of disjunction, this suffices for (91) to map that proposition to 1 as well. Clearly, the same holds if John brought beer but not wine except that it is the other relevant proposition that is mapped to 1. By the askability condition (91) can thus be asked in a world in which John brought exactly one of the things mentioned. In fact it can only be asked in such worlds. Note that the exactly-one meaning component of AQs is derived as a presuppositional by-product. Moreover, note that this derives the intuition that an AQ raises the issue which of p and q is 1.[22]

[22]Recall Polish AQs such as (i) once more. One possible representation involves disjunction of polar questions with a silent coordinator. A reviewer asks why this coordinator cannot be interpreted

4.4 Intermediate summary and discussion

Let me briefly recapitulate. I suggested that disjunction in AQs scopes above the question operator in contrast to PDQs. The pitch accents on the disjuncts were analyzed as being mutually exclusive foci. Assuming a trivalent semantics and the new askability condition, the general question operator was suggested to contribute a presupposition regarding the question's direct answers. This derives the desired denotational difference between AQs and PDQs. Moreover, the adoption of the standard Strong Kleene semantics for disjunction derives the exactly-one meaning component of AQs from general facts about presupposition projection for free.

This account is in a position to meet the explanatory challenge laid out in (57) and repeated in (92) given that all of the interpretative differences between AQs and PDQs reduce to the hypothesized scopal differences between the two.

(92) *The explanatory challenge raised by the disjunctive question hypothesis*
The hypothesized scope difference between AQs and PDQs is to be implicated in the explanation of their observed interpretative differences.

Note furthermore that the account immediately explains why a *both-* or a *neither-*response to the AQ in (93) is slightly degraded without some sort of collocation like *well actually* challenging the exactly-one presupposition of the question.

(93) Q: Did John bring the /BEER, or did he bring the WINE\?
A: ?(Well actually,) he brought both.
A′: ?(Well actually,) he brought neither.

In section 3.1, I said that the AQ in (94) could have an LF such as (95a) with LF scoping of the disjunction. The present analysis can be extended to this. I will not give a detailed proof of this but just point out how it can be done. Assume a bivalent semantics for the moment with presuppositions encoded as partial functions. The scoped disjunction can be interpreted as a quantifier, (95c), over question-abstracts such as (95b). After conversion in (95d), it becomes apparent that we are dealing with a disjunction of polar questions again. Using the definitions in the preceding sections, this can then be easily translated into a trivalent semantics with the desired results.[23]

(94) Did John bring the /BEER or the WINE\?

(95) a. $[_X\ [_Y$ the beer or the wine] $[_Z\ 2[$? [Exh_C John brought t_{2_F}]]]]
b. $[\![\mathbf{Z}]\!]^g = \lambda x.\lambda w.\lambda p : p = [\![\mathbf{Exh}_C\ \mathbf{John\ brought\ t}_{2_F}]\!]^{g[x/2]}\ .\ p(w) = 1$
c. $[\![\mathbf{Y}]\!]^g = [\![\mathbf{or}_q]\!]^g(\lambda f_{\langle e,\langle s,\langle st,t\rangle\rangle\rangle}.f(\text{the beer}))(\lambda f_{\langle e,\langle s,\langle st,t\rangle\rangle\rangle}.f(\text{the wine}))$

conjunctively. The reason is that the intersection of the two polar questions is necessarily empty.

(i) Anna kupiła /BLUZkę czy spódNIcę\?
Anna bought blouse czy skirt
'Which of a blouse or a skirt did Anna buy?'

[23]The F-mark here sits on the trace ensuring the correct focus value (Nicolae 2013). Alternatively, there might be an exhaustivity operator on each disjunct thereby getting scoped. This would avoid having an F-mark on the trace. However, it would complicate the composition considerably by necessitating multiple type shifting operations. I must leave this for future research.

d. $[\![\mathbf{X}]\!]^g =$
$[\![\mathbf{or}_q]\!]^g(\lambda w.\lambda p : p = \lambda w'.\text{J brought beer and not wine in } w'.p(w) = 1)$
$(\lambda w.\lambda p : p = \lambda w'.\text{J brought wine and not beer in } w'.p(w) = 1)$

5 Intonation, pragmatics, and embedding

5.1 Exhaustivity and redundancy

Consider (96). Without mutually exclusive foci the analysis discussed would predict only a true alternative requirement. Now, exhaustivity is crucially not a general property of focus. So why is a non-exhaustive analysis not available for (96)?

(96) Did John bring the /BEER or the WINE\?

That mutual exclusiveness is a defining property of AQs is shown by the degradedness of (97). Even if there is an exhaustivity operator present in the second disjunct, it does not negate *France* as that is entailed by *Paris*. It seems that the impossibility of Exh having an effect in the second disjunct is crucial for the degradedness of (97). Conversely, Exh having an effect in (96) seems crucial for its acceptability. Consequently mutual exclusiveness must be obligatory in AQs.

(97) #Does John live in /FRANCE or in PARIS\?

5.1.1 Redundancy in assertions

I propose to connect the issue to the phenomenon of Hurford disjunctions such as (98), of which (97) is reminiscent. Intuitively, the assertion in (98) is degraded because one of the disjuncts entails the other (Hurford 1974, Chierchia et al. 2012).

(98) #John lives in France or in Paris.

How is this constraint to be implemented? Following Meyer (2013) and Katzir and Singh (2014), I assume that (98) is a violation of a constraint against redundancy. I assume that the constraint in question is defined as in (99) with the ancillary definition of *(maximal) simplification* in (100) (see Katzir 2007). In contrast to these other formulations, (99) is applicable to assertions and questions. α, β, and γ are neither restricted to propositions nor to questions. $\oplus$ stands for *and* or *or*.[24] Applied to a propositional sentence with coordination, (99) says that it is infelicitous if in all worlds where it is true its content could be expressed by using a structurally simpler, yet semantically equally strong or stronger sentence — namely by a sentence with only one of the coordinates and without strengthening through Exh operator. Quantification over p and q is vacuous in the propositional case.

[24] Extending (99) to any type of connective would at the least require discussion of the semantics of conditionals which I must leave for the future due to limitations of space. Suffice it to say that the formulations of the redundancy condition found in Meyer (2013), Katzir and Singh (2014) a.o. face parallel issues (see Mayr and Romoli 2016 for discussion). I will also not discuss Hurford disjunctions with more than one disjunct. As is known these pose additional issues for the theories cited. The present one is no exception here. At the moment, I do not know how to solve this issue.

(i) #John lives in France or in Paris or in Spain.

(99) *Redundancy constraint*
$[\ldots \alpha \oplus \beta \ldots] \in D_{\langle s,\langle \tau,t\rangle\rangle}$, where τ is $\varnothing$ or $\langle s,t\rangle$, is infelicitous if for all worlds w where there is a p such that $[\![[\ldots \alpha \oplus \beta \ldots]]\!]^g(w)(p) = 1$ there is a $\gamma \in D_{\langle s,\langle \tau,t\rangle\rangle}$ such that γ is a maximal simplification of $[\ldots \alpha \oplus \beta \ldots]$, there is q such that $[\![\gamma]\!]^g(w)(q) = 1$, $[\![\gamma]\!]^g = [\![[\ldots \alpha \oplus \beta \ldots]]\!]^{g[\alpha\oplus\beta\to\alpha]}$ or $[\![\gamma]\!]^g = [\![[\ldots \alpha \oplus \beta \ldots]]\!]^{g[\alpha\oplus\beta\to\beta]}$, and $[\![\gamma]\!]^g \Rightarrow [\![[\ldots \alpha \oplus \beta \ldots]]\!]^g$.

(100) a. ψ is a simplification of ϕ if ψ is derived from ϕ by a series of replacements of nodes in ϕ with subconstituents in ϕ or lexical items and/or deletions of nodes in ϕ.
b. ψ is a maximal simplification of ϕ if ψ is a simplification of ϕ and any Exh present in ϕ is absent in ψ.

Now, (101) is a maximal simplification of (98). It is moreover equivalent to one of its disjuncts and to (98) itself. Therefore by (99), (98) is infelicitous.

(101) John lives in France

This would wrongly block (102a). As pointed out by Meyer (2013) and Katzir and Singh (2014), however, (102a) is felicitous under the parse in (102b). Consider a situation where John read some but not all of the books. The maximal simplification in (102c) is true in it, but not the one in (102d). Now, (102c) is not equivalent to any of the disjuncts in (102b), in particular not to the first one, which states that John read some but not all of the books. Neither of (102c) or (102d) is thus preferred to (102a) in such a situation making it felicitous according to (99).

(102) a. John read some or all of the books.
b. [Exh John read some of the books] or [John read all of the books]
c. John read some of the books
d. John read all of the books

Note that in order for the account of acceptability of (102a) not to extend to (98), *France* must not be interpreted as strengthened *France but not Paris* in (98). All accounts of (98) must assume something like this. Singh (2008), for instance, argues that strengthening would lead to a contradiction and is therefore blocked (see also Meyer 2013).

In contrast to the works cited above, (99) does not require equivalence between a sentence and a proper subset of its possible simplifications for the former to be infelicitous. Rather it requires entailment from a maximal simplification to the sentence. Since (99) moreover requires equivalence to one of the coordinates, this change in formulation does not make a difference for the cases considered.[25]

It does make a difference, however, for unembedded disjunctions such as (103a). Each of the maximal simplifications in (103b) and (103c) is equivalent to one of

[25] Two remarks: first, without the equivalence requirement (102a) would be blocked by its maximal simplifications as they entail it. Second, (99) also makes (ia) infelicitous as desired: its maximal simplification (ib) is equivalent both to one of its conjuncts and to (ia).

(i) a. #John lives in Paris, and in France.
b. John lives in Paris

the disjuncts and entails (103a) on its inclusive interpretation. Moreover, in each world in which (103a) is true on its inclusive interpretation, one of (103b) or (103c) is true. The redundancy constraint (99) thus blocks the inclusive interpretation of (103a). The exclusive interpretation of (103a), on the other hand, is neither entailed by (103b) nor by (103c). For instance, (103b) is true when John brought both the beer and the wine, but (103a) interpreted exclusively is not. Therefore, (99) allows (103a) only under the exclusive interpretation.

(103) a. John brought the beer or the wine.
b. John brought the beer
c. John brought the wine

Only the present formulation of the redundancy constraint draws a connection between Hurford disjunctions and the exclusive interpretation of unembedded disjunctions. However, Singh's 2008 observation that the disjuncts should be inconsistent to each other is a precursor to this. Essentially, the present redundancy constraint incorporates this requirement in a stronger version.[26] This will be crucial for the account of mutual exclusiveness in AQs.

5.1.2 Redundancy in questions

(99) applied to a coordinated question says that the questions cannot be used if the following holds: whenever it has a true direct answer there is a maximal simplification which has a true direct answer and is equivalent to a question with only one of the coordinates, and there moreover is entailment from that maximal simplification to the coordinated question.[27]

Consider first (97). Without Exh operators one of its representations would be (104a). Whenever (104a) maps a possible direct answer to 1, namely when John lives in France, the maximal simplification (104b) does so too. (104b) is equivalent to one of the disjuncts. Finally, whenever (104b) maps its possible direct answer to 1, (104a) maps that same proposition to 1. That is, the former entails the latter. Given this (97) without Exh operators is blocked by (99).[28]

[26]Note that disjunction embedded under negation as in (i) is correctly not predicted to be read exclusively. The reason is that neither of its maximal simplifications, i.e., its disjuncts, entails it.

(i) a. John didn't bring the beer or the wine.
b. John didn't bring the beer
c. John didn't bring the wine

[27]Entailment for questions, I assume, reflects the subset relation similarly to assertions:

(i) Q entails Q', $Q \Rightarrow Q$, iff $\forall w.\forall p[Q(w)(p) = 1 \rightarrow Q'(w)(p) = 1]$.

[28]Two remarks: first, if (97) receives the LF scoping representation in (ia), the same result obtains. The maximal simplification in (ib) is equivalent to (104b) given that *in Paris* is not a scope-bearing expression and therefore makes (ia) infelicitous. The same holds for the examples to follow.

(i) a. [[in France or in Paris] 2[? [John lives t_2]]]
b. [[in France] 2[? [John lives t_2]]]

Second, one can now see why the redundancy condition is formulated with entailment from a simplification to the utterance rather than equivalence between the two (see e.g. Meyer 2013, Mayr and

(104) a. [? [John lives in France]] or [? [John lives in Paris]]
b. [? [John lives in France]]

Now consider (97) with Exh operators as in (105). If *France* in the second disjunct were interpreted as *France and not Paris*, (97) should be acceptable. The reason for this is that the maximal simplification in (104b) is not equivalent to any of the disjuncts then. We saw the same issue with acceptable Hurford assertions such as (98). As said above, I must therefore stipulate that *France* must be interpreted as non-strengthened. Then (105) is unacceptable for the same reason that (104a) is. Note again that this assumption is not unique to the present proposal.

(105) [? [Exh_C [J lives in France_F]]] or [? [Exh_D [J lives in Paris_F]]]

Now, consider the version of (96) without Exh operators in (106a). Each maximal simplification, i.e., (106b) or (106c), is equivalent to one of the disjuncts. In addition each entails (106a). Finally, in each world in which (106a) maps a possible direct answer to 1, one of the maximal simplifications does too. The redundancy constraint (99) therefore blocks (106a). This is parallel to how the inclusive interpretation of disjunctive assertions is blocked.

(106) a. [? [John brought the beer]] or [? [John brought the wine]]
b. [? [John brought the beer]]
c. [? [John brought the wine]]

At last, consider (96) with Exh operators as in (107). Again, (106b) and (106c) are the maximal simplifications. However, neither is equivalent to one of the disjuncts of (107). This suffices to make (107) felicitous, similar to how the exclusive interpretation of disjunctive assertions is forced.[29]

(107) [? [Exh_C [J brought the beer_F]]] or [? [Exh_D [J brought the wine_F]]]

Thus, (96) and AQs generally are only felicitous with mutually exclusive foci. With-

Romoli 2016). Unlike assertions, Hurford questions are not equivalent to their simplifications.

[29] In (ia) and (ib) the disjuncts express the same issue. So why are they acceptable? I suggest that this is an incrementality effect (Fox 2008, Singh 2008, Mayr and Romoli 2016): (ia) and (ib) are acceptable because the redundancy constraint also takes continuations after *or* other than the one actually used into account (Schlenker 2008). (ia) and (ib) would only be infelicitous then if in all of these alternatives one also finds a redundancy violation. It is plain that this is not the case for (ia) and (ib). Incrementality, however, does not seem to play a role in all potential violations of redundancy (Singh 2008, Mayr and Romoli 2016). For instance, both (iia) and (iib) are as degraded as their inverted counter-parts. This is unexpected by an incremental redundancy condition. For what it's worth, however, the questions in (i) pattern with their corrsponding assertions in (iii). I must leave the issue when incrementality matters and when it does not for future research.

(i) a. Does it /RAIN or NOT\?
b. Is Bill at /HOME or at WORK\?

(ii) a. #Does John live in /PARIS or in FRANCE\?
b. #John lives in Paris or in France.

(iii) a. It rains or it doesn't.
b. John is at home or at work.

out such mutual exclusiveness, an AQ would contain redundant material. If mutual exclusiveness is independently impossible as in Hurford questions — whatever the reason may turn out to be for that in the end — unacceptability arises.

5.2 Final fall intonation and the scope of disjunction

While the account of AQs offered in section 4 has the pitch accents make a semantic contribution, the seemingly obligatory final fall intonation is not directly implicated in the proposal. This sets the present account apart from (Biezma and Rawlins 2012) and (Truckenbrodt 2012), and to some extent also (Pruitt and Roelofsen 2011). Under these proposals the intonation is essential to the difference between PDQs and AQs. In fact, Pruitt and Roelofsen (2013) provide experimental evidence that it is exactly the final fall intonation that acts as the crucial cue leading English speakers to interpret a disjunctive question as an alternative one. In other words, a PDQ interpretation for (108a) and an AQ one for (108b) should be blocked somehow.

(108) a. Did John bring the /BEER or the WINE\?
b. Did John bring the beer or the wine/?

At this point, it must be noted that final fall intonation is neither specific to AQs nor to disjunctions, as the examples in (109) show, and as first discussed in the semantics literature by Zimmerman (2000).[30]

(109) a. John brought the /BEER or the WINE\.
b. John brought the /BEER and the WINE\.

On the one hand, we have thus reasons to assume that final fall intonation is not the crucial element contributing AQ meaning. On the other hand, it remains a fact that such questions are always accompanied by this contour, even in Polish as the degradedness of the example in (110) combining *czy* with a final rise intonation, repeated from (40), shows.

(110) *Anna kupiła bluzkę czy spódnicę/?
Anna bought blouse czy skirt

To account for this pattern, I suggest that in the unmarked case coordination is associated with final fall intonation. This straightforwardly accounts for why both disjunction and conjunction in assertions can show this pattern as in (109). The final fall intonation itself is, however, neither tied to assertions nor to questions. Thus also AQs can have the final fall intonation. But why must (108a) have the AQ interpretation? And why can (108b) only have the PDQ interpretation?

I make the further assumption that the intonation associated with a particular type of syntactic structure only surfaces if it is not embedded in a structure associated with its own conflicting intonation pattern. Something like this seems independently necessary to account for the fact that sentences with embedded po-

[30] It is unclear at this point how the propositional (109) can be made compatible with Biezma and Rawlins's 2012 account, as they acknowledge. On Pruitt and Roelofsen's 2011 proposal, final fall intonation would be semantically informative in (109a) but might have to be vacuous in (109b).

lar questions such as (111) do not show the rising intonation of the embedded clause but rather the falling one typical for assertions (Truckenbrodt 2012).

(111) John knows whether Mary brought the beer\.

Assuming that the question operator ? is associated with final rise intonation, (108a) and (108b) come out as unambiguous: in an AQ representation, the disjunction embeds ?. Therefore the final rise intonation associated with ? cannot surface, but the final fall intonation of disjunction must. That is (108a) obtains. In the PDQ representation, disjunction scopes over ?. Therefore the picture is reversed. Only the final rise intonation is possible and (108b) is the result. This straightforwardly extends to Polish, in particular (110).[31] [32]

Now, even when coordination is arguably in an unembedded position it is not always associated with a final fall intonation, for instance in (112). When one compares (112) to (109b), however, it seems fairly clear that the latter is the unmarked case in terms of intonation, as I assumed above. Indeed, (112) seems most natural when continued with a statement of ignorance about what else John brought or a question about this. In other words, coordinations with open intonation indicate incompleteness in terms of coordinates (see Zimmerman 2000, Biezma and Rawlins 2012, Roelofsen and Farkas 2015). The speaker is aware that there should be another coordinate in (112)— which would bear the final fall — but is unable to produce it for whatever reason. Possibly coordinations with such open intonation have a conventionalized meaning associated to them to this effect.

(112) John brought the /BEER, and the /WINE ...

In light of the point about (112), it might be that even the final fall intonation contributes a specific meaning component indicating completeness (see in particular

[31] A reviewer reminds me that under certain conditions polar questions can have a falling intonation and that this is even the standard in certain dialects of English (Grabe et al. 2005).

[32] Importantly, final fall intonation appears if it is not in conflict with the overall intonation. For instance, it is not in conflict with the falling intonation of assertions as in (109). Embedded AQs as in (i) are another case in point.

(i) John knows whether Mary brought the /BEER or the WINE\.

(ii) is another such case. It is only compatible with the context under the narrow scope construal of disjunction. That is, final fall intonation is allowed in (ii) because it is compatible with the overall intonation of assertions. I thank a reviewer for bringing up such examples.

(ii) *Context: Not all students drink and not all smoke, but each has a vice.*
Every student /DRINKS or SMOKES\.

Relatedly, Pruitt and Roelofsen (2011) suggest that final fall intonation is not able to appear in the scope of downward monotonic expressions. Thereby (iii) should only have the inverse scope interpretation available. An earlier version of this paper suggested something similar. I am not so sure anymore, however. The surface scope interpretation of the example asymmetrically entails its inverse scope one. Consequently, the sentence might be acceptable in the context in (iii) for two reasons: either because the surface scope interpretation is available, or because the underinformative inverse scope one is. There is no way to tell. I leave further investigation for future research.

(iii) *Context: All students are teetotalers and non-smokers.*
No student /DRINKS or SMOKES\.

Biezma and Rawlins 2012). This is, however, not essential for an AQ interpretation to come about in the present proposal. Working out the suggestions made about intonation in detail must, however, be left for the future.

5.3 Responding to disjunctive questions

I now discuss the restrictions disjunctive questions place on possible responses.

5.3.1 Response particles

Recall that both *yes* and *no* can be used as responses to PDQs but not to AQs:

(113) Q: Did John bring the beer or the wine/?
A: Yes. / No.

(114) Q: Did John bring the /BEER or the WINE\?
A: #Yes. / #Yes, he brought the beer. / #Yes, he brought the wine.
A′: #No. / #No, he brought neither.

Note that *yes* and *no* as responses to AQs do not improve when occurring with an accompanying statement indicating what is the case. Roelofsen and Farkas (2015) note that in precisely this they differ from *or-not*-questions (see also Krifka 2013). While bare *yes* and *no* are equally unacceptable here, they improve markedly if accompanied by such a clarifying statement:

(115) Q: Did John bring the /BEER or NOT\?
A: #Yes. / Yes, he did.
A′: #No. / No, he didn't.

Roelofsen and Farkas's 2015 account of response particles is in principle compatible with the present system. Discussion would, however, be involved. Krifka's 2013 account does not immediately account for the facts regarding AQs, while Kramer and Rawlins's 2009 account is shown by Krifka to be in need of modification. Given all this I choose to briefly indicate how a trivalent system might deal with the limited data set above. The result owes to both insights by Krifka (2013) and Roelofsen and Farkas (2015). A full treatment of *yes* and *no* including their use as responses to assertions is, however, beyond the scope of this paper.[33]

Consider the trivalent entries for *yes* and *no* in (116) and (117), respectively. Both of them come with an index i whose denotation must be anaphorically resolved. The denotation of $g(i)$ is required to be a question. Now, for a *yes*-response

[33] In particular, I leave open the question how *yes* and *no* come to be ambiguous as responses to negative polar questions in the sense that they can be followed by both affirming and negating statements, as in (i), but not when used as responses to *or-not*-questions, as in (ii).

(i) Q: Did John not bring the wine/?
A: Yes, he did not. / Yes, he DID
A′: No, he did not. / No, he DID.

(ii) Q: Did John bring the /BEER or NOT\?
A: #Yes, he did not. / Yes, he DID
A′: No, he did not. / #No, he DID .

to be true, there must be a true direct answer p to question $g(i)$ in w. A *no*-response, on the other hand, is true if there is a false direct answer to $g(i)$ in w, where a false direct answer is a possible direct answer that is false in w. In both cases, it is required that at most two possible direct answers exist, which must moreover be negations of each other. The third value obtains if there is no direct answer in w.

(116) $$[\![\mathbf{yes}_i]\!]^g = \lambda w_s.\begin{cases} 1 \text{ if } \exists p.g(i)(w)(p) = 1 \wedge \forall p[\exists w'.g(i)(w')(p) \neq \# \rightarrow \\ \quad \forall q[[q \neq p \wedge \exists w'.g(i)(w')(q) \neq \#] \rightarrow q = \lambda w'.\neg p(w')]] \\ 0 \text{ if } \exists p.g(i)(w)(p) = 0 \wedge \forall p[\exists w'.g(i)(w')(p) \neq \# \rightarrow \\ \quad \forall q[[q \neq p \wedge \exists w'.g(i)(w')(q) \neq \#] \rightarrow q = \lambda w'.\neg p(w')]] \\ \# \text{ if } \neg\exists p.g(i)(w)(p) \neq \# \vee \exists p, q[p \neq q \wedge \exists w'.g(i)(w')(p) \neq \# \wedge \\ \quad \exists w'.g(i)(w')(q) \neq \# \wedge q \neq \lambda w'.\neg p(w')] \vee g(i) \notin D_{\langle s,\langle st,t\rangle\rangle} \end{cases}$$

(117) $$[\![\mathbf{no}_i]\!]^g = \lambda w_s.\begin{cases} 1 \text{ if } \exists p.g(i)(w)(p) = 0 \wedge \forall p[\exists w'.g(i)(w')(p) \neq \# \rightarrow \\ \quad \forall q[[q \neq p \wedge \exists w'.g(i)(w')(q) \neq \#] \rightarrow q = \lambda w'.\neg p(w')]] \\ 0 \text{ if } \exists p.g(i)(w)(p) = 1 \wedge \forall p[\exists w'.g(i)(w')(p) \neq \# \rightarrow \\ \quad \forall q[[q \neq p \wedge \exists w'.g(i)(w')(q) \neq \#] \rightarrow q = \lambda w'.\neg p(w')]] \\ \# \text{ if } \neg\exists p.g(i)(w)(p) \neq \# \vee \exists p, q[p \neq q \wedge \exists w'.g(i)(w')(p) \neq \# \wedge \\ \quad \exists w'.g(i)(w')(q) \neq \# \wedge q \neq \lambda w'.\neg p(w')] \vee g(i) \notin D_{\langle s,\langle st,t\rangle\rangle} \end{cases}$$

Assume that $g(i)$ has as its denotation the PDQ in (113). There is only one possible direct answer to a PDQ, allowing both *yes* and *no*. If John brought the beer or the wine, then a true direct answer to $g(i)$ exists, namely *that John brought the beer or the wine*. *Yes* is thus licensed, whereas *no* is not. However, if John brought neither beer nor wine, there is a false direct answer to $g(i)$. Only *no* can be truthfully uttered.

Assume next that $g(i)$ is the AQ in (114). In that case, neither *yes* nor *no* can be used as a response. The reason is that the two possible direct answers are not negations of each other. Both *yes* and *no* would be # in that case.[34]

Finally assume that $g(i)$ is the *or-not*-question in (115). Here the possible direct answers do form negations of each other allowing for *yes* and *no* in principle. The problem with bare *yes*- and *no*-responses, however, is that they are both equally felicitous in situations in which John brought the beer and situations in which he did not. In other words, bare responses are ambiguous when used as a reply to an *or-not*-question, which is why they must be accompanied by a clarifying statement.[35]

[34] Two notes are in order: First, in order to capture the impossibility of *yes*- and *no*-responses with AQs as in (i), it might be necessary to make the response-particles sensitive to the polarity of the antecedents in the AQ. I thank a reviewer for pointing this out.

(i) Q: Is the door /OPEN or CLOSED\?
A: #Yes, open. / #No, closed.

Second, wh-questions, while not dealt with in this paper, would disallow *yes* and *no* as responses for the same reason as AQs, envisioning a Karttunen-like extension of the present trivalent system. The possible direct answers to a wh-question are similarly not negations of each other.

[35] In (i)— an adaption of an example in (Bolinger 1978:89) — the simple polar question is much more appropriate than the corresponding *or-not*-question (see also van Rooy and Safarova 2003, Biezma and Rawlins 2012 a.o.).

(i) *Context: There has been no prior discussion between A and B about John's party.*

5.3.2 Open disjunctive questions[36]

Roelofsen and van Gool (2010) and Roelofsen and Farkas (2015) draw attention to what they refer to as open disjunctive questions. As the example in (118) shows, such open disjunctive questions in contrast to both AQs and PDQs consist of two final rises. Since *yes* and *no* can serve as responses, the exactly-one meaning component appears absent. Different from PDQs, however, *yes* must be accompanied by a specification as to which of the two propositions is true.

(118) *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.
(Roelofsen and Farkas 2015:364)

Crucially, open disjunctive questions are also available with two full polar questions with a final rise on each, and responses parallel to those in (118) are possible:

(119) Does he speak English/, or does he speak French/?

If (119) were a disjunction of two polar questions, the present account would incorrectly predict a true alternative requirement for it and thereby disallow *no*-responses, similar to AQs. I think that (119) should, however, be best analyzed as a sequence of two separate polar questions. This avoids the problem. To this end notice that conjunction and disjunction can be used sentence initially as in (120) and (121). The latter would be a case with a polar question having *or* sentence initially. The sequence of A's utterances in (121), I suggest, is parallel to (119).

(120) A: John speaks English.
B: I know.
A: And (he speaks) French, too.

(121) A: Does he speak English/?
B: Not as far as I know.
A: Or (does he speak) French/?

(121) only shows that *or* can introduce a polar question. It does, however, not show that (119) cannot be a disjunction of polar questions. But there is a possible

A: I hear John is having a party ...
a. Are you going to the party/?
b. #Are you /GOING to the party or NOT\?

Recall that by the definition of question speech act in (68) a speaker uttering a question requests to be told the possible direct answers to the question that are true in w. But then if *that B goes to the party* is 0 in w, one is strictly speaking not required to react at all when confronted with (ia). But not so in the face of (ib). Given the presupposition of questions, (ib) always maps one proposition to 1. Therefore the addressee must act. (ib) is a more urgent and thus less polite question so to speak than (ia). When asking (ia), we pretend that the addressee has options in responding, but not so when asking (ib), similar to suggestions by Biezma and Rawlins (2012).

[36]This section arose as a response to a reviewer's insightful questions.

argument for this stronger view. A disjunction of two full polar questions is unembeddable when interpreted as an open disjunctive question. Consider (122). The non-monotonic operators *exactly one* and *only* allow us to tease apart the various interpretations the embedded question might receive.[37]

(122) *Context: John thinks Igor speaks neither English nor French. Bill and Frank both think that Igor speaks either English or French but not both. Each of Bill and Frank considers both options possible.*

a. #Exactly one man is certain whether Igor speaks English or whether he speaks French.

b. #Only JOHN is certain whether Igor speaks English or whether he speaks French.

The non-factive predicate *be certain* when embedding a question states that a potential answer to it is true in all of the subject's belief worlds (see section 5.4.3). To begin with, notice that (122a) and (122b) with the question interpreted as an AQ are false or a presupposition failure, respectively, in the context: none of the three individuals stands in the *be certain*-relation to one of the answers to the AQ. This contradicts the upward monotonic component of *exactly one* and *only*.

If the question is interpreted as a PDQ, (122a) and (122b) are false. In the context, the negative answer to the PDQ — *that Igor doesn't speak English or French* — is true in all of John's belief worlds. However, the positive answer — *that Igor speaks English or French* — is true in all of Bill's and Frank's belief worlds. That is, for each individual exactly one of the potential answers to the PDQ is true in the context, violating the downward monotonic requirement of *exactly one* and *only*.

Finally, if the embedded question were interpreted as an open disjunctive question, (122a) and (122b) would be true. First, in the context the *no*-answer in (118b) — *that Igor doesn't speak English or French* — is true in all of John's belief worlds. This satisfies the upward monotonic requirement of *exactly one* and *only*. Second, for both Bill and Frank there is no answer that is true in all of their respective belief worlds. In particular, each of their belief worlds is such that exactly one of the *yes*-answers in (118a) — *that Igor speaks English* and *that Igor speaks French* — is true in it. Moreover, their belief worlds vary as to which of the *yes*-answers is true in it. This satisfies the downward monotonic requirement.

Under an analysis that does not treat open disjunctive questions as constituents and therefore sees them as unembeddable the unacceptability of (122a) and (122b) is correctly predicted. Only AQs and PDQs are embeddable on such a view, and we have seen that these lead to unacceptability in the context.[38]

If these suggestions are on the right track, the present account does not make a prediction regarding (119) at all. Open disjunctive questions correspond to two separate polar questions and are not syntactically coordinated. With regards to the semantic impact of *or* in such cases, I tentatively suggest that it is an instance

[37] Moreover, the non-factive responsive predicate *be certain* is used, as factive *know* would lead to complications. In particular, use of *know* would trigger competition between the question-embedding case and a declarative-embedding case. This would make (122) independently degraded.

[38] A reviewer reminds me that there might be other, independent reasons for why open disjunctive questions are unembeddedable. This is correct, but in the absence of such an account I will treat (122) as suggestive evidence. Needless to say that more research on this issue is necessary.

of discourse-level disjunction, as in (123). It attaches to a question Ψ, is coindexed with a preceding question Φ, and contributes a definedness condition requiring that Φ and Ψ form subquestions of the immediate question under discussion (QUD). If that is satisfied, discourse-level *or* returns the plain meaning of Ψ. For instance, the immediate QUD in (118) would be the wh-question *Which language(s) does Igor speak?*, as the context makes clear. In a structured discourse model along the lines of Roberts (1996) and Büring (2003), the two PDQs in (119) qualify as immediate subquestions of that wh-question. Therefore the use of discourse-level *or* would be licensed. These suggestions, obviously, are in need of more careful research than space permits here.

(123) $[\![\mathbf{Or}_i\ \Psi]\!]^g = [\![\Psi]\!]^g$
def. iff $g(i)$ and $[\![\Psi]\!]^g$ are subquestions of the immediate QUD

The proposal for *yes* and *no* responses sketched in section 5.3.1 can also be extended to the pattern found in (118). In brief, a bare *yes* response is ambiguous: it could indicate that either the first or the second polar question has a true direct answer and is to be answered with *yes*. Therefore a disambiguating accompanying statement is needed. A similar ambiguity would arise with bare *no*. Recall, however, that the definition of a question speech act in (68) asks a cooperative interlocutor to tell the speaker of the sequence of polar questions which possible direct answers are mapped to 1 by them. Thus upon hearing bare *no* the speaker can conclude that the interlocutor does not assume that any of the questions has a true direct answer, i.e., both are to be answered with *no*.[39]

5.4 Embedded questions

The account so far predicts that direct disjunctive questions with wide scope disjunction are interpreted as AQs with an exactly-one presupposition. This presupposition is derived in a trivalent semantics making use of a condition on speech acts, namely the askability condition. As such it does not follow straightforwardly that embedded disjunctive questions have similar presuppositions.

As the examples in (124) and (125) show, however, both rogative and responsive predicates (Lahiri 2002) are able to embed AQs. In order to bring the AQ reading out more clearly, consider first what (124a) and (125a) are not supposed to mean, namely *'Either Mary asked/knows whether John brought the beer, or she asked/knows whether he brought the wine'*.

(124) a. Mary asked whether John brought the /BEER or the WINE\.

[39] Conjunctive polar questions such as (i) also have conjunction at the discourse-level. Standard conjunction is impossible due to the empty intersection (see footnote 22). Note that a final fall intonation as in (ii) is impossible in contrast to conjunctive assertions (see section 5.2). The impossibility of standard conjunction together with the treatment of final fall intonation in section 5.2 predicts this gap. Now the response *John brought the beer* settles both questions in (i). By (68) a cooperative interlocutor should name the true direct answers to the questions in (i). By naming only one for the first question, one reasons that he does not assume the second question to have a true direct answer.

(i) Did John bring the beer/? And did he bring the wine/?

(ii) #Did John bring the /BEER and did he bring the WINE\?

b. Mary wondered whether John brought the /BEER or the WINE\.

(125) a. Mary knows whether John brought the /BEER or the WINE\.
b. Mary found out whether John brought the /BEER or the WINE\.

Now, a difference between (124) and (125) must be noted. (125a) and (125b), on the one hand, strongly suggest that John brought exactly one of the things mentioned. (124a) and (124b), on the other hand have the inference that Mary believes that John brought exactly one of the things. This difference does not reflect the responsive-rogative distinction. The responsive predicate *be certain* in (126) also contributes the weaker inference that Mary believes that John brought exactly one of the things.[40]

(126) Mary isn't certain whether John brought the /BEER or the WINE\.

These intuitions can be strengthened by considering the differences between (127a), (127b), and (127c) in the context given. This context does not entail the exactly-one presupposition. It only holds in Mary's doxastic alternatives. (127a) and (127c) are acceptable, which suggests that the presuppositions of the embedded AQs get modified in the way just discussed. That is, (127a) and (127c) only place the requirement that Mary believes the exactly-one component to hold on the context. (127b), on the other hand, is distinctly odd. The reason for this would be that the presupposition of the AQ is inherited as a whole conflicting with the context.

(127) *Context: Either John brought both the beer and the wine, or he brought neither. Mary falsely believes he brought exactly one of them.*
a. Mary asked whether John brought the /BEER or the WINE\.
b. #Mary knows whether John brought the /BEER or the WINE\.
c. Mary isn't certain whether John brought the /BEER or the WINE\.

I will now show that the difference between *ask* and *be certain*, on the one hand, and *know*, on the other hand, is due to the fact that only the latter predicate is factive. Before doing so I discuss simple embedded polar questions.[41]

[40] I thank a reviewer for pointing to *be certain.* The example uses negation for two reasons: first, for some speakers *whether*-interrogatives under *be certain* are somewhat degraded in upward monotonic environments (Egré 2008). Second, negation shows directly that the inference discussed is a presupposition as it projects through it. Relatedly, embedding (124a) as in (ia) under negation is degraded (see also footnote 32). However, embedding under a negative existential quantifier as in (ib) suggests that everyone believes that John brought exactly one of the things. This is as expected. Presuppositions project universally from the scope of negative existential quantifiers (see Schlenker 2008, 2009, Fox 2013 and citations there). Similarly, (ic) with embedding under an existential modal suggests that Mary may believe that John brought exactly one of the things, which is again as expected (Beaver 2001).

(i) a. #Mary didn't ask whether John brought the /BEER or the WINE\.
b. No one asked whether John brought the /BEER or the WINE\.
c. Mary may ask whether John brought the /BEER or the WINE\.

[41] In this paper I do not deal with the question why emotive factive predicates like *surprise* embed wh-questions but not AQs or polar questions (see Grimshaw 1979, Guerzoni 2007, Sæbø 2007, Nicolae 2013, Romero 2015, Roelofsen et al. to appear a.o.):

(i) a. Mary is surprised by who brought the beer.

5.4.1 Embedded polar questions

Consider the polar question in (128) again, repeated from (66).

(128) Did John bring the beer?

The possible direct answer to (128) corresponds to the proposition *that John brought the beer.* Crucially, *that John did not bring the beer* is not a possible direct answer.

But then potentially an issue arises with respect to embedded polar questions such as (129). Assume John did not bring the beer. (129) is true in that situation if and only if Mary believes that he did not do so. So it seems that Mary must stand in the believe relation to the negative answer to the embedded polar question. But how is this possible under the present semantics?

(129) Mary knows whether John brought the beer.

For this reason, I adapt Heim's 1994 strong answer operator (see also Beck and Rullmann 1999, Sharvit 2002) to the present setting. This operator when applied to a question denotation returns the strong exhaustive answer to it. As defined in (130), it comes with a world variable w^* whose denotation is the world of evaluation w. It takes a question denotation Q and returns a proposition. This proposition when applied to a world w' returns a value different from # only if there exists a proposition that Q does not map to #. In other words, the strong answer operator requires that Q has either a true or a false direct answer.[42] If this requirement is satisfied, the proposition resulting from applying the operator to Q in w' returns 1 if the set of true direct answers to Q in w' is what it is in w, and 0 if not. In other words, modulo the presupposition the true exhaustive answer to a question Q, as defined in (78), generally entails the strong exhaustive answer.

(130) $[\![\textbf{[Ans w*]}\ \Phi]\!]^g =$

$$\lambda w'.\begin{cases} 1 \text{ if } \exists p.[\![\Phi]\!]^g(w)(p) \neq \# \wedge \{p : [\![\Phi]\!]^g(w)(p) = 1\} = \{p : [\![\Phi]\!]^g(w')(p) = 1\} \\ 0 \text{ if } \exists p.[\![\Phi]\!]^g(w)(p) \neq \# \wedge \{p : [\![\Phi]\!]^g(w)(p) = 1\} \neq \{p : [\![\Phi]\!]^g(w')(p) = 1\} \\ \# \text{ if } \neg\exists p.[\![\Phi]\!]^g(w)(p) \neq \# \end{cases}$$

Furthermore, I adopt the standard semantics for *know* in (131).[43] Given the discussion above, the LF of the sentence in (129) should look as in (132).

(131) $$[\![\textbf{know}\ \phi]\!]^g = \lambda x_e.\lambda w_s.\begin{cases} 1 \text{ if } [\![\phi]\!]^g(w) = 1 \wedge x \text{ believes } [\![\phi]\!]^g \text{ in } w \\ 0 \text{ if } [\![\phi]\!]^g(w) = 1 \wedge \neg x \text{ believes } [\![\phi]\!]^g \text{ in } w \\ \# \text{ if } [\![\phi]\!]^g(w) \neq 1 \end{cases}$$

(132) [Mary knows [Ans w* [? [John brought the beer]]]]

The denotation of the answer operator applied to the question *Did John bring the*

b. *Mary is surprised by whether John brought the /BEER or the WINE\.
c. *Mary is surprised by whether John brought the beer.

[42] This latter condition is not part of Heim's 1994 original operator, but it appears necessary once questions contribute presuppositions. Related requirements have been independently proposed in the literature (see Dayal 1996, Beck and Rullmann 1999, Abrusán and Spector 2011 a.o.).

[43] The usual qualifications regarding further meaning components apply (e.g. Gettier 1963).

beer? in (128) above is the proposition in (133). It returns a definite truth-value only in case *Did John bring the beer?* maps its possible direct answer *that John brought the beer* to either 1 or 0, which it does as long as there is beer. Thus if John brought the beer in w, (133) is the proposition returning 1 in world w' if *Did John bring the beer?* maps its possible direct answer to 1 in w'. If he did not bring the beer in w, (133) returns 1 in world w' if *Did John bring the beer?* maps that proposition to 0 in w'. In other words, (133) states the true answer is whatever is the case.

(133) $[\![\textbf{Ans w* [? [John brought the beer]]}]\!]^g = [\![\textbf{Ans w*}]\!]^g([\![\textbf{(128)}]\!]^g) =$

$$\lambda w'.\begin{cases} 1 \text{ if } \exists p.[\![\textbf{(128)}]\!]^g(w)(p) \neq \# \wedge \{p : [\![\textbf{(128)}]\!]^g(w)(p) = 1\} = \{p : [\![\textbf{(128)}]\!]^g(w')(p) = 1\} \\ 0 \text{ if } \exists p.[\![\textbf{(128)}]\!]^g(w)(p) \neq \# \wedge \{p : [\![\textbf{(128)}]\!]^g(w)(p) = 1\} \neq \{p : [\![\textbf{(128)}]\!]^g(w')(p) = 1\} \\ \# \text{ if } \neg\exists p.[\![\textbf{(128)}]\!]^g(w)(p) \neq \# \end{cases}$$

The truth-conditions of (132) are as in (134). By the assertability condition, (134) bears the trivial presupposition that the strong exhaustive answer to the question *Did John bring the beer?* is 1. Through this the presupposition of the answer is inherited as only in this case the answer is 1 according to (130). (134) is thus true if Mary believes the strong exhaustive answer and false if she does not believe it.

(134) $[\![\textbf{(132)}]\!]^g =$

$$\lambda w.\begin{cases} 1 \text{ if } [\![\textbf{Ans w*}]\!]^g([\![\textbf{(128)}]\!]^g)(w) = 1 \wedge \text{Mary believes } [\![\textbf{Ans w*}]\!]^g([\![\textbf{(128)}]\!]^g) \text{ in } w \\ 0 \text{ if } [\![\textbf{Ans w*}]\!]^g([\![\textbf{(128)}]\!]^g)(w) = 1 \wedge \neg\text{Mary believes } [\![\textbf{Ans w*}]\!]^g([\![\textbf{(128)}]\!]^g) \text{ in } w \\ \# \text{ if } [\![\textbf{Ans w*}]\!]^g([\![\textbf{(128)}]\!]^g)(w) \neq 1 \end{cases}$$

By employing the answer operator, we thus derive seemingly correct truth-conditions for embedded polar questions even without negative possible direct answers.

5.4.2 AQs embedded under factive predicates

Recall (135), repeated from (125a) above. I noted that such examples come with the familiar exactly-one presupposition.

(135) Mary knows whether John brought the /BEER or the WINE\.

Given the discussion in the preceding section, the LF of (135) is (136).

(136) [Mary knows [Ans w* [$_X$ whether J brought the /BEER or the WINE\ ]]]

Recall again the denotation for the AQ embedded in (136). It maps a proposition to 0 if it is mapped to 0 by both embedded polar questions. Due to the fact that a proposition cannot be equivalent to both possible direct answers *that John brought the beer and not the wine* and *that John brought the wine and not the beer*, the AQ cannot map any proposition to 0. Now, the answer operator requires that there be a proposition that the AQ maps to either 1 or 0. Since no proposition can be mapped to 0, the answer operator effectively requires that one of the relevant propositions be mapped to 1. Since, moreover, not both propositions can be mapped to 1 at the same time, the overall requirement is the exactly-one presupposition, as in (137):

(137) $[\![\textbf{Ans w* [whether John brought the /BEER or the WINE\ ]}]\!]^g =$

$$\lambda w'.\begin{cases} 1 \text{ if } \exists p.[\![\mathbf{X}]\!]^g(w)(p) \neq \# \wedge \{p : [\![\mathbf{X}]\!]^g(w)(p) = 1\} = \{p : [\![\mathbf{X}]\!]^g(w')(p) = 1\} \\ 0 \text{ if } \exists p.[\![\mathbf{X}]\!]^g(w)(p) \neq \# \wedge \{p : [\![\mathbf{X}]\!]^g(w)(p) = 1\} \neq \{p : [\![\mathbf{X}]\!]^g(w')(p) = 1\} \\ \# \text{ if } \neg\exists p.[\![\mathbf{X}]\!]^g(w)(p) \neq \# \end{cases}$$

Finally, the truth-conditions of (136) are as in (138) stating that the sentence is true only if Mary believes the strong exhaustive answer in (137). By the assertability condition (138) presupposes that this answer is 1 in the world of evaluation w. For (137) to yield 1 in w, John must have brought exactly one of the beer or the wine in w. Consequently, the exactly-one presupposition of an AQ is inherited by the whole sentence if the question is embedded under a factive predicate like *know*.

(138) $[\![\textbf{(136)}]\!]^g = \lambda w.$

$$\begin{cases} 1 \text{ if } [\![\textbf{Ans w*}]\!]^g([\![\mathbf{X}]\!]^g)(w) = 1 \text{ and} \\ \quad \text{Mary believes } [\![\textbf{Ans w*}]\!]^g([\![\mathbf{X}]\!]^g) \text{ in } w \\ 0 \text{ if } [\![\textbf{Ans w*}]\!]^g([\![\mathbf{X}]\!]^g)(w) = 1 \text{ and} \\ \quad \neg\text{Mary believes } [\![\textbf{Ans w*}]\!]^g([\![\mathbf{X}]\!]^g) \text{ in } w \\ \# \text{ if } [\![\textbf{Ans w*}]\!]^g([\![\mathbf{X}]\!]^g)(w) \neq 1 \end{cases}$$

5.4.3 AQs embedded under non-factive predicates

Recall that AQs under non-factive predicates such as in (139) carry the inference that Mary believes that John brought exactly one of the beer or the wine.

(139) a. Mary asked whether John brought the /BEER or the WINE\.
b. Mary isn't certain whether John brought the /BEER or the WINE\.

Consider the non-factive responsive *be certain*. I assume that the representation of (139b) is parallel to the one for the sentence with *know* discussed, i.e., as in (140).

(140) not [M certain [Ans w* [$_X$ whether J brought the /BEER or the WINE\ ]]]

Intuitively, we want (139b) to express that Mary does not believe any possible answer to the AQ (Spector and Egré 2015, Uegaki 2015). For this result to obtain the lexical entry for *be certain* needs to have an existential quantifier binding the world variable w^* in (140), as in the case yielding 1 in (141). (141) shows the standard universal quantification over the subject's doxastic alternatives. In addition, however, the entry has the assignment function relative to which the embedded clause ϕ is interpreted modified so that w^* is mapped to w' and bound by a quantifier.

(141) $[\![\textbf{certain } \phi]\!]^g = \lambda x_e.\lambda w_s.$

$$\begin{cases} 1 \text{ if } \forall w'' \in Dox_{x,w}.\exists w' : [\![\phi]\!]^{g[w'/w^*]}(w'') \neq \# \wedge \\ \quad \exists w'.\forall w'' \in Dox_{x,w} : [\![\phi]\!]^{g[w'/w^*]}(w'') = 1 \\ 0 \text{ if } \forall w'' \in Dox_{x,w}.\exists w' : [\![\phi]\!]^{g[w'/w^*]}(w'') \neq \# \wedge \\ \quad \forall w'.\exists w'' \in Dox_{x,w} : [\![\phi]\!]^{g[w'/w^*]}(w'') = 0 \\ \# \text{ if } \exists w'' \in Dox_{x,w}.\forall w' : [\![\phi]\!]^{g[w'/w^*]}(w'') = \# \end{cases}$$

With (141) the truth-conditions for (140) are then as in (142): we get 1 if there is no possible answer to the AQ that Mary believes, 0 if there is a possible answer that Mary believes, and # if in one of Mary's doxastic alternatives each of the answers

is mapped to #. The latter is the case if one of Mary's doxastic alternatives is such that either John brought both beer and wine or neither. By the assertability condition (140) thereby presupposes that Mary believes that John brought exactly one of the things, as desired.[44]

(142) $[\![\textbf{(140)}]\!]^g =$

$$\lambda w.\begin{cases} 1 \text{ if } \neg[\forall w'' \in Dox_{j,w}.\exists w' : [\![\textbf{Ans w*}]\!]^{g[w'/w^*]}([\![\textbf{X}]\!]^{g[w'/w^*]})(w'') \neq \# \wedge \\ \quad \exists w'.\forall w'' \in Dox_{j,w} : [\![\textbf{Ans w*}]\!]^{g[w'/w^*]}([\![\textbf{X}]\!]^{g[w'/w^*]})(w'') = 1] \\ 0 \text{ if } \neg[\forall w'' \in Dox_{j,w}.\exists w' : [\![\textbf{Ans w*}]\!]^{g[w'/w^*]}([\![\textbf{X}]\!]^{g[w'/w^*]})(w'') \neq \# \wedge \\ \quad \forall w'.\exists w'' \in Dox_{j,w} : [\![\textbf{Ans w*}]\!]^{g[w'/w^*]}([\![\textbf{X}]\!]^{g[w'/w^*]})(w'') = 0] \\ \# \text{ if } \exists w'' \in Dox_{j,w}.\forall w' : [\![\textbf{Ans w*}]\!]^{g[w'/w^*]}([\![\textbf{X}]\!]^{g[w'/w^*]})(w'') = \# \end{cases}$$

For *ask* in (139a) one might adopt a solution similar to the one discussed for *be certain*. There is, however, also another option. I said that direct questions are subject to the askability condition. It seems natural to require of predicates reporting the asking of a direct question or reporting an inner question to incorporate the askability condition in their lexical semantics. Consider (143). *Ask* takes a question-denotation as its argument and contributes the requirement that the subject believes that there is a proposition that answers the question. This together with the assertability condition will conspire to yield the presupposition for (139a) that Mary believes that John brought exactly one of the things mentioned.[45]

(143) $[\![\textbf{ask } \Phi]\!]^g =$

$$\lambda x_e.\lambda w_s.\begin{cases} 1 \text{ if } x \text{ believes } \exists p.[\![\Phi]\!]^g(w)(p) \neq \# \text{ in } w \text{ and } x \text{ asks } [\![\Phi]\!]^g \text{ in } w \\ 0 \text{ if } x \text{ believes } \exists p.[\![\Phi]\!]^g(w)(p) \neq \# \text{ in } w \text{ and } \neg x \text{ asks } [\![\Phi]\!]^g \text{ in } w \\ \# \text{ if } \neg x \text{ believes } \exists p.[\![\Phi]\!]^g(w)(p) \neq \# \text{ in } w \end{cases}$$

6 Evaluation of the proposal

I now evaluate the proposal by discussing the cross-linguistic picture and setting it in relation to the existing literature. For more in-depth discussion of the cross-linguistic picture I refer the reader to Biezma and Rawlins (2015).

[44] A number of remarks are in order. First, in the case of an embedded declarative the existential quantification in (141) is vacuous as there is no world variable w^* to bind. In other words, (141) can also be used when embedding declaratives. Second, Spector and Egré (2015) have argued for such existential quantification over worlds even for *know* and other factive predicates when embedding questions. Discussing this in depth here would lead too far afield. Third, in the declarative embedding case the presupposition of (141) yields the requirement that the subject believe the presupposition of the embedded clause. This is a welcome result (see Karttunen 1974, Heim 1992).

[45] Two notes are in order. First, Krifka's 2001b view, where cases like (139a) are instances of embedded speech acts, might derive similar results in a more parsimonious fashion if the askability condition is extended to embedded speech acts. Second, a reviewer notes the case of rogative *depend*. Since it does not report the asking of a question, an entry similar to (143) would not make sense. In contrast to (139a), however, (i) suggests that John brings exactly one of the things mentioned. That is, *depend* is similar to factive predicates in this respect. I must leave this for future research.

(i) Whether Mary will come depends on whether John brings /BEER or WINE\.

6.1 Disjunctive questions from a cross-linguistic perspective

6.1.1 Languages with structural differences between disjunctive questions

Han and Romero (2004b) discuss Hindi disjunctive questions. On the one hand, if the verb precedes the whole of the second disjunct as in (144), an AQ interpretation ensues. On the other hand, if the verb follows the second disjunct, as in (145), the question must be construed as a PDQ. Taken together and given standard assumptions about constituency, this suggests that in Hindi AQs employ at least VP-disjunction, whereas PDQs use NP- or DP-disjunction.

(144) (Kyaa) Chandra-ne **coffee** pii **yaa chai**?
what Chandra-Erg coffee drink-Pfv or tea
'Which of these two things did Chandra drink: coffee or tea?'
(Han and Romero 2004b:539)

(145) (Kyaa) Chandra-ne **coffee yaa chai** pii?
what Chandra-Erg coffee or tea drink-Pfv
'Is it the case that Chandra drank coffee or tea?'
(Han and Romero 2004b:538)

While strictly speaking only VP-level disjunction would be required by (144), it is important to see that the pattern is fully compatible with the present account: PDQs have disjunction below the question level. This is observed by the representation in (146) for (145). If AQ interpretations depend on question-level scope of the disjunction as assumed in the present account, LF-scoping of the disjunction must not be an option in Hindi as it would allow an AQ interpretation for (145). If that much is granted, the AQ in (144) can be seen to have the representation in (147) with material deleting under identity.

(146) [? [Chandra-ne [[coffee] yaa [chai]] pii]]

(147) [[? [Chandra-ne coffee pii]] yaa [? [~~Chandra-ne~~ chai ~~pii~~]]]

Uegaki (2014) notes that a pattern completely parallel to Hindi is observed in Japanese. I refer the reader to his paper for the data. He further shows that in an AQ it is full polar questions that are disjoined. The evidence stems from the interpretations available for (148). When there is a modal following the second pronounced verb, this modal under an AQ interpretation can only be read as being part of the second disjunct, as in (148b). If AQs had involved disjunction below the question-level, it should have been possible to share the modal across the disjuncts as in the unavailable (148a). Thus disjunction in (148) happens at the question-level, and therefore Japanese is compatible with the present proposal.[46]

(148) Taro-ga koohii-o nomu ka ocha-o nomu-**hazu**-ka?
Taro-NOM coffee-ACC drink KA tea-ACC drink-must-Q
a. *'Which is true: Taro must drink coffee or he must drink tea?'

[46] (148) does not contain brackets as in the original. (148) also can be read as a PDQ. Note that the question marker and the disjunctive marker are homophonous. In light of the observed ambiguity, the *KA*-gloss is meant to be unspecified with respect to which of the two meanings is used.

b. ‘Which is true: Taro drinks coffee or he must drink tea?’
(Uegaki 2014:50)

6.1.2 Evidence for high disjunction in English

We already saw that disjunctions of full polar questions necessitate an AQ interpretation even in English. Now, Beck and Kim (2006) note that focus operators cause intervention in AQs based on the degradedness of examples like (149).[47]

(149) #Does only JOHN like /MARY or SUSAN\? (Beck and Kim 2006:167)

The authors follow Beck (2006) in the assumption that intervention effects arise if a focus operator intervenes between another focus operator and its associated focus. (150) is a representation of (149) compatible with the present assumptions. Following Beck (2006) the *only*s evaluate all foci in their scope. As a consequence they evaluate the foci on *John*, *Mary* and *Susan*. But then the Exh operators do not have any foci left to evaluate anymore. Recall that Exh requires that its alternatives form a subset of the focus value of its sister node. If the foci are all evaluated by the lower *only*s, however, this requirement can never be fulfilled because the focus value will be a singleton set. (149) is therefore unacceptable. Of course, reversing Exh and *only* would lead to a similar problem.

(150) [? [Exh_C [$\text{only}_{C'}$ [John_F like Mary_F]]]] or
[? [Exh_D [$\text{only}_{D'}$ [~~John_F~~ ~~like~~ Susan_F]]]]

Moreover, Han and Romero (2004a) note that an AQ interpretation is impossible with preposed negation as in (151).[48]

(151) *Didn’t John drink COFfee or TEA? (Han and Romero 2004a:180)

Han and Romero (2004a) suggest that preposed negation makes a verum focus operator necessary in each disjunct. For this to be possible, however, disjunction must occur at least at the proposition-level. Now, Beck and Kim (2006) suggest that (151) should be seen as intervention by this operator. (152) is a representation of (151) compatible with the present account that is predicted to cause intervention.

(152) [? [Exh_C [verum [neg_F [John brought the beer_F]]]]] or
[? [Exh_D [verum [~~neg_F~~ [~~John~~ ~~brought~~ the wine_F]]]]

6.1.3 Languages with distinct disjunctive markers

The disjunctive marker used in AQs has been reported to differ from the one used in PDQs and declarative sentences for a number of languages. For instance, while *ala* forces an AQ interpretation in Basque, *edo* is only compatible with a PDQ interpretation in addition to its use in declaratives:

[47] Stress is not indicated in the original example. I modified this to facilitate judgement.

[48] If negation is not preposed the resulting example is acceptable as an AQ. Given the discussion in the text of Han and Romero’s 2004a analysis, this means that (i) does not involve a verum operator.

(i) Did John not drink COFfee or TEA? (Han and Romero 2004a:180)

(153) a. Te-a **ala** kafe-a nahi duzu?
tea-ART or coffee-ART want you.it
'Which of the coffee and the tea do you want?'
b. Te-a **edo** kafe-a nahi duzu?
tea-ART or coffee-ART want you.it
'Do you want tea or coffee?' (Haspelmath 2007:(70))

Basque also has an interrogative marker *al* (Hualde and de Urbina 2003 a.o.) possibly related to *ala* so that (153a) might be a disjunction of full polar questions as in the second analysis entertained for Polish AQs in section 3.3.2, i.e., (51).

Consider next Mandarin Chinese. Here the declarative disjunctive marker in (154b) is also found in PDQs, while the special marker in (154a) is reserved for AQs. The question marker is the unrelated *ma*.

(154) a. Nǐ yào wǒ bāng nǐ **háishi** yào zìjǐ zuò
you want I help you or want self do
'Do you want me to help you, or do you want to do it yourself?'
b. Wǒmen zài zhèli chī **huòzhe** chī fàndiàn dōu xíng
we at here eat or eat restaurant all OK
'We can either eat here or eat out' (Haspelmath 2007:(11))

Similar facts have been reported for Finnish (Karttunen 1977) and Egyptian Arabic (Winans 2012). Such languages are compatible with the present suggestions. They might lexicalize proposition-level and question-level disjunction, what I have termed or_p and or_q respectively, separately. Recalling section 3.3.2 on Polish AQs, they could thus either employ LF scoping as in the first option entertained there, (48), or disjunction of full polar questions as in the second option in (51).

Korean is relevant in this respect given Han and Romero's 2004b discussion. While PDQs use the marker *na* to disjoin NPs or DPs, as in (155), AQs use *animyen* — literally meaning *'if not'* — that is independently known to be only applicable at the clausal level, as in (156). Crucially, in contrast to the Chinese data above each disjunct in (156a) involves the question-marker *ni* even though it looks as if VPs were disjoined. This suggests that Korean AQs might be disjunctions of polar questions, i.e., conforming to the second option in (51). If so, this potentially provides evidence for separate lexicalization of or_p and or_q. In contrast to what we have seen so far, optional deletion under identity targets material in the first disjunct, as (156b) shows. The authors note that this is a general fact about Korean.

(155) Chelswu-ka **khophi-na cha-lul** masi-ess-ni?
Chelswu-Nom coffee-or tea-Acc drink-Past-Int
'Is it the case that Chelswu drank coffee or tea?'
(Han and Romero 2004b:543)

(156) a. Chelswu-ka **khophi-lul** masi-ess-ni animyen **cha-lul**
Chelswu-Nom coffee-Acc drink-Past-Int if-not tea-Acc
masi-ess-ni?
drink-Past-Int
'Which of these two things did Chelswu drink: coffee or tea?'
b. Chelswu-ka **khophi-lul** animyen **cha-lul** masi-ess-ni?
Chelswu-Nom coffee-Acc if-not tea-Acc drink-Past-Int

'Which of these two things did Chelswu drink: coffee or tea?'
(Han and Romero 2004b:543)

6.1.4 Alternative questions with proposition-level disjunction

Howell (2016) reports that in Yoruba disjunction in AQs arguably does not take question-level scope even though it scopes higher than in PDQs. AQs are formed by movement of the disjunctive phrase above the focus marker *ni* as in (157a). This creates a cleft-structure contributing mutual exclusiveness. Crucially, the movement is to a position below the question marker *ṣe*. Without movement a PDQ interpretation is mandatory as in (157b).

(157) a. Ṣe bata tabi iwe **ni** Kemi ra?
Q shoes or book FOC Kemi buy
'Which of the shoes and the book did Kemi buy?'
b. Ṣe Kemi ra bata tabi iwe?
Q Kemi buy shoes or book
'Did Kemi buy shoes or a book?' (Howell 2016:(2))

Howell suggests that AQ meanings are to be derived for Yoruba employing an alternative semantics. Is this compatible with the present proposal? It turns out that the answer might be affirmative. Yoruba AQs seem to have a mutual exclusiveness but not a true alternative meaning component. That is, (157a) is infelicitous if the speaker considers it possible that Kemi bought both the shoes and the book — as expected — but felicitous if he is not certain whether Kemi bought anything. On the present account the true alternative requirement is a consequence of question-level disjunction. Therefore if disjunction has narrow scope as in Yoruba this inference is not expected to be present. This, however, also suggests that there might be substantial cross-linguistic differences in the compositional systems involved.

6.2 Existing accounts of disjunctive questions

On the basis of Polish, I argued that question-level scope for disjunction is crucial for an AQ interpretation. Moreover, we saw that a number of languages is compatible with this picture and that Korean and Japanese lend support to it, provided the relevant particles can be taken to be question operators. Remember furthermore that based on the puzzle posed by Polish I formulated the explanatory challenge repeated in (158). Arguably, the present account satisfies (158).

(158) *The explanatory challenge raised by the disjunctive question hypothesis*
The hypothesized scope difference between AQs and PDQs is to be implicated in the explanation of their observed interpretative differences.

(158) consists of two sub-challenges: not only the denotational difference between AQs and PDQs but also the presuppositional one is to be tied to the scope difference. I now evaluate previous proposals with regards to these two points.

6.2.1 Existing accounts and differences in denotation

To start recall the difference in acceptability between (159a) and (159b): the presence of a second *whether* in (159a) forces question-level disjunction and therefore an AQ interpretation for the embedded question. Due to the absence of the final fall intonation, however, unacceptability results. (159b) is acceptable because the intonation properties match the forced question-level disjunction.

(159) a. *Maria asks whether Anna bought a blouse or whether she bought a skirt.
b. Maria asks whether Anna bought a /BLOUSE or whether she bought a SKIRT\.

Pruitt and Roelofsen's 2011 and Uegaki's 2014 accounts are similar to the present one with respect to (159). Analyses relying on LF scoping for disjunction alone to achieve an AQ interpretation, however, must be enriched so as to allow for the overt disjunction of polar questions in order to derive the full range of AQs. With LF scoping alone it would not be clear what the disjunction should be scoping over in (159b) thereby possibly deriving a non-scoped interpretation. Such accounts include Larson (1985), Groenendijk and Roelofsen (2009), Nicolae (2013).

Proposals where disjunction of any constituent can in principle lead to an AQ denotation without LF scoping face certain issues with respect to (159). Let me discuss the nature of such accounts a bit more in detail by sticking mostly to Romero and Han's 2003 one. First, their semantic system in principle can derive an AQ interpretation for (160) with the representation in (161). Here disjunction of DPs occurs and a wh-expression is moved from the disjunction, essentially contributing existential quantification in the sense of Karttunen (1977) which is restricted by the denotations of the two DPs in the disjunction. In Beck and Kim's 2006 and Biezma and Rawlins's 2012 accounts existential closure occurs without movement.[49]

(160) Did John bring the /BEER or the WINE\?

(161) [wh_1 [Q [John brought [t_1 the beer or the wine]]]]

If the system can assign an AQ denotation to (161), it follows that the denotational differences observed between PDQs and AQs cannot be tied to the scope of disjunction. The problem is that, again, such accounts derive non-existing meanings for disjoined polar questions such as in (159b) without amendments, as noted by Biezma and Rawlins (2012). Their own account relying on Hamblin semantics can account for why (159b) is possible. As they concede in their footnote 37, however, it does not immediately follow from it that overt question-level disjunction *obligatorily* leads to an AQ denotation. That is, without further assumptions the degradedness of (159a) is unaccounted for. A non-final fall intonation is allowed for such cases and correlates with a PDQ interpretation in their account as well.

[49] The precise interpretation of disjunction in AQs depends on the specific account, but crucially its interpretation differs from the one in PDQs. Only Biezma and Rawlins's 2012 account allows for a fully uniform interpretation of disjunction regardless of the environment.

6.2.2 Existing accounts and differences in presupposition

I now show that the scope difference between AQs and PDQs is not directly connected to the presuppositional one in alternative proposals. I only discuss accounts that worry about the exactly-one component and treat it as a presupposition.

Both Romero and Han (2003) and Biezma and Rawlins (2012) suggest that AQs come with the presupposition that for any world in the context set there is exactly one proposition in the question denotation that is true in it. In particular on Biezma and Rawlins's 2012 view this presupposition is contributed by the final fall intonation. Given its prosodic status, it might attach to clausal disjunctions only, which would go some way of meeting the presuppositional part of the explanatory challenge. The specific requirement entertained, however, seems too strong. Consider the AQ in (162). Intuitively, it presupposes that John brought the beer or the wine alone, or both. In the two proposals under discussion the question denotation is of the form {*that John brought the beer*, *that John brought the wine*, *that John brought the beer and the wine*}. Now, if the last of these propositions is true, the other two must be true as well. But in that case the requirement that exactly one proposition in the question denotation is true would be violated. Thus the assumed presupposition incorrectly predicts that the proposition *that John brought the beer and the wine* cannot be an answer to (162) and that the question could not possibly be asked if the speaker entertains that possibility.

(162) Did John bring the /BEER, the /WINE, or BOTH\?

Pruitt and Roelofsen (2011) have a way of deriving the exactly-one component that does not run into issues with (162). They too relate it to the prosodic contour of AQs thereby addressing part of the explanatory challenge. Working in the framework of inquisitive semantics, the contour contributes exhaustification at the matrix-level adding the exactly-one component as a so-called imposition. Impositions are assumed to be a new type of non-at-issue content to be distinguished from presuppositions in that they impose a requirement on the common ground rather than presuppose a specific one (see also Murray 2014, AnderBois et al. 2015). Their non-at-issue status accounts for the infelicity of *both*- and *neither*-responses to AQs. Exhaustification via the final-fall contour is, however, crucially thought to be general in inquisitive semantics. It also applies to disjunctions in declaratives as in (163) deriving the familiar exclusivity meaning component. Now, a *both*-response is much less marked in such a case than it is in the case of an AQ. This is unexpected. What is more, Pruitt and Roelofsen (2011) suggest that a *no*-response should be blocked in any case in such situations, as is the case with AQs.

(163) A: John brought the /BEER or the WINE\.
B: No, he brought both.

Uegaki (2014) assumes that an AQ is embedded by an answer operator inspired by Dayal's 1996 maximal true answer operator. This operator contributes the presupposition that in each world in the context set there be a true proposition in the question denotation entailing all other true propositions in it. Now, assuming the denotation {*that John brought the beer*, *that John brought the wine*} for (160) the propositions in it are logically independent. Therefore whenever one is true, the

other must be false. Given that it is presupposed that one must be true, the exactly-one presupposition is derived for (160). This account does not have problems with (162) either. Thus Romero and Han (2003) and Biezma and Rawlins (2012) could possibly adopt that solution, too. Also note that the exactly-one presupposition is derived from general assumptions about question semantics.

This proposal, however, makes the prediction that the example in (164) repeated from (97) should be acceptable, if nothing further is said. (164) receives the denotation {*that John lives in Paris*, *that John lives in France*} in Uegaki's account. The former proposition entails the latter. As a consequence the answer operator cannot require that only one of the propositions is true, and no mutual exclusiveness is derived for (164).

(164) #Does John live in /PARIS or in FRANCE\?

There is an obvious answer to both the issue in (162) and the one in (164). We already know that redundancy considerations make (164) degraded. But these considerations also predict mutual exclusive foci for (162). The question denotation would be {*that John brought the beer and not the wine*, *that John brought the wine and not the beer*, *that John brought the beer and the wine*}. Only one of these can ever be true, obviously. Romero and Han (2003), Biezma and Rawlins (2012), Uegaki (2014) could thus adopt mutually exclusive foci and account for the exactly-one presupposition in full generality. Crucially, Dayal's answer operator would not be the culprit of the mutual exclusiveness requirement anymore. If that is granted, however, what these accounts really need to derive is the true alternative requirement.

Could Dayal's 1996 answer operator at least be the reason for the latter? Nicolae (2013) argues that it is by coupling it with embedded exhaustification. The latter ingredient enables her to derive for (160) as denotation {*that John brought the beer and not the wine*, *that John brought the wine and not the beer*}. The true alternative requirement of the AQ is derived by the second ingredient, the answer operator. Since this operator is also used for wh-questions, it follows that a true alternative requirement is also predicted in these cases. There is, however, a contrast between AQs and wh-questions in the sense that a negative answer is much more felicitous in the latter case, as the difference between (165) and (166) shows. The present proposal does not predict the response in (166) to be degraded like the one in (165), because the true alternative requirement is not contributed by a general answer operator but rather by disjunction, which is absent from wh-questions.[50]

(165) Q: Did John bring the /BEER or the WINE\?
A: #Neither.

(166) Q: What did John bring/?
A: Nothing.

[50]Note that singular *which*-questions, as in (i) do seem to pattern with AQs. This difference between (i) and (166) further reinforces the conclusion that a general answer operator should not be made responsible for the true alternative requirement.

(i) Q: Which of the beer and the wine did John bring/?
A: #Neither.

Finally, any account connecting the true alternative requirement to an operator embedding AQs wrongly forces that requirement on AQs in Yoruba (see section 6.1.4). The present proposal does not do so as discussed above.

7 Conclusion and outlook

This paper presented evidence from Polish suggesting that AQs and PDQs differ in the scope of disjunction. In particular, only in the former case disjunction has question-level scope. Question-level scope is achieved either by disjunction of polar questions or by LF scoping. The particular intonation patterns reflect the difference in the scope of disjunction as well. Finally, the paper developed a novel account of the strong correlation between AQ denotations and the exactly-one meaning component. The prerequisites for this were mutually exclusive foci, motivated by redundancy considerations, and a new presuppositional semantics for the question operator. A trivalent Strong Kleene semantics was then shown to automatically derive the exactly-one meaning component through presupposition projection.

A number of questions for future research suggest themselves. First, the cross-linguistic landscape should be better understood. Second, one could ask whether Strong Kleene semantics is crucial for the proposal. It appears that other trivalent accounts such as supervaluationism could achieve similar results. It remains to be seen, however, whether dynamic accounts or Schlenker's 2009 restatement of such accounts in a static system could do the same. For this question to be addressed fruitfully, the local contexts employed in questions must be better understood.

Third, the consequences of a presuppositional semantics for questions in general should be further investigated. For instance, is the question operator suggested in this paper adequate for wh-questions as well? If one wants to use a similar semantics for wh-questions as for polar questions and AQs, one would have to make wh-expressions presuppositional themselves, as in the bivalent meaning for *who* in (167), for instance. Here the denotation of *who* takes a question-abstract and incorporates it into the presupposition as a whole. A new question is thus created. But, of course, other options exist as well. To investigate these, it might be helpful to look at presupposition projection from wh-questions in future research.

(167) $[\![\textbf{who}]\!]^g =$
$\lambda f_{\langle e,\langle s,\langle st,t\rangle\rangle\rangle}.\lambda w_s.\lambda p_{st} : \exists x[x \text{ is human in } w \wedge f(x)(w)(p) \neq \#]\ .\ p(w) = 1$

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