

The Prosodic Cues Used in the Disambiguation of Disjunctive Questions

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Abstract

Ambiguous disjunctive questions in English have been a large area of research in the field of formal semantics. A disjunctive question, such as *Would you like coffee or tea?*, can be interpreted as a polar question or an alternative question. The ambiguity lies in the underlying syntactic structure of the questions, and this ambiguity is resolved by the use of prosodic features. Despite the importance of prosodic features in the disambiguation of these questions, this topic has received little attention in the field of phonetics. This has resulted in semanticists resorting to introspection and lack of empirical evidence in order to characterise the prosodic features necessary to disambiguate the questions. Recent experimental evidence has suggested that the final contour is the most salient cue used in disambiguation. In this study we further investigated this claim. We conducted a forced-choice listening task in which native speakers of English were asked to interpret various disjunctive questions, which differed in their prosodic features. Using logistic regression to create a model, we found that accenting, the presence of a prosodic boundary and the final contour were statistically significant predictors of the interpretation. We conclude that accenting on the disjuncts and the prosodic phrasing of the questions are more salient than has been stated in the literature. Furthermore we stress that semanticists, who wish to develop semantic models of disjunctive questions, must include a range of prosodic features if they intend to present an accurate account of how speakers resolve this ambiguity.

Abstract (Dutch)

Ambigue disjunctieve vragen in het Engels vormen een groot onderzoeksgebied binnen de formele semantiek. Een vraag zoals *'Do you want coffee or tea?'*, heeft zowel een polaire interpretatie als een alternatieve interpretatie. De ambiguïteit wordt veroorzaakt door een verschil in de onderliggende syntactische structuur. In spraak wordt deze ambiguïteit opgelost door het gebruik van verschillende prosodische factoren. Ondanks het belang van prosodie, heeft dit onderwerp weinig aandacht gekregen binnen de fonetiek. Dit heeft ertoe geleid dat de semanticus vaak introspectie gebruikt om de prosodische factoren te bepalen die belangrijk zijn in het ondubbelzinnig maken van disjunctieve vragen. Recent experimenteel onderzoek concludeert dat de laatste toonhoogtecontour de belangrijkste factor is in het bepalen van de betekenis van een disjunctieve vraag. In deze studie hebben wij deze claim verder onderzocht. In een luisterexperiment werden moedertaalsprekers van het Engels gevraagd om verschillende disjunctieve vragen te interpreteren die verschilden in hun prosodische

kenmerken. De resultaten waren gemodelleerd met binaire logistische regressie in R. Wij vonden dat accenten op de disjuncten, prosodische frasering en de laatste toonhoogtecontour statistisch significante voorspellers waren voor de interpretatie van de vragen. Wij concluderen dat het accentueren van de disjuncten en de aanwezigheid van een frasegrens belangrijker zijn dan is vermeld in de literatuur. Verder benadrukken we dat semantici, die semantische modellen van disjunctieve vragen willen ontwikkelen, meerdere prosodische factoren moeten gebruiken als zij een feitelijk model willen ontwikkelen over hoe sprekers deze dubbelzinnigheid oplossen.

Keywords: Prosody, Semantics, Disjunctive Questions, and Phonetics

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0. Introduction

While formal languages of logic are used to capture the semantics of language, they often encounter problems when describing natural language. The problem lies in a very specific difference between a natural language and a logical language, namely ambiguity. While a logical language allows no ambiguity, the natural languages that we speak are full of it.

The ambiguity in written language can occasionally lead us to laugh at an ambiguous newspaper headline, but in spoken language can usually be resolved using the context, or by prosodic cues, for example intonation and accenting. In the field of formal semantics we need appropriate models to capture these ambiguities, but we also need the help of phoneticians to characterise the prosodic cues used in disambiguation. This of course involves interdisciplinary work between both semanticists and phoneticians, work which is rather sparse. While semanticists heavily rely on introspection, which alone cannot be trusted, the phonetician doesn't often work on topics of relevance to the semanticist (Šafářová, 2004). Furthermore 'semantic descriptions of intonation are usually dismissed by phoneticians because of their lack of empirical evidence' (Šafářová, 2004:1). In the research area of English disjunctive questions, which will be the topic of this paper, various semantic models have been proposed that use prosodic features as a key component (see; Aloni & van Rooij (2002), Bartels (1999), Han & Romero (2004) and Roelofsen & van Gool (2010)). These studies have focused on one cue as being most salient and have failed to examine the intricacies of prosodic structure. We will be examining this topic independent of a particular semantic model, and hope to give a more detailed account of the prosodic factors that distinguish one interpretation from the other.

In a forced-choice listening task we will investigate the importance of accenting, the presence of a prosodic boundary and the final intonation contour in the disambiguation of prosodic questions. In section 1 we will give an overview of methodology in question semantics, and introduce the syntax and semantics of disjunctive questions. In section 2 we will introduce the prosodic cues which typify disjunctive questions, and in section 3-5 we will investigate these roles by conducting a fixed-choice listening task with 20 native speakers of English. Finally in section 6 we will discuss the results of our experiment in light of the present literature on the subject.

1. Natural language semantics

1.1 Formal Semantics and Interrogatives

Formal semantics is a field within linguistics, philosophy and computing, which attempts to formalise the semantic knowledge that speakers of natural languages possess. In order to do this, logical languages such as propositional logic and predicate logic are used. These formal languages are not ambiguous, our natural languages on the other hand are.

The formal analysis of interrogatives differs fundamentally from the analysis of declaratives. While the analysis of propositions or indicative sentences relies on the truth conditions of the proposition, the formal semantics of interrogatives relies on *answerhood* conditions because a question cannot be either true or untrue (Aloni, Dekker & Butler, 2007:5). A question however does demand an answer, which *can* be true or untrue.

To be considered valid, the answer must also be felicitous. Answering a polar question by saying ‘cow’ for example would not be felicitous. In short, interrogatives are analysed based on the set of possible answers that comply with the answerhood conditions. Ambiguity arises when an expression or word has more than one meaning (Gillon, 1990:394). If the semantic meaning of a question is defined by the set of possible answers, then a question with an ambiguous interpretation will give rise to more than one set of felicitous answers. As we will see in section 1.3, the ambiguity found in disjunctive questions leads to two distinct sets of possible answers.

1.2 Disjunction in Logic and Natural Language

In classical propositional logic, disjunction is a logical operator \vee , which conjoins two sentences together, for example $p \vee q$. In natural language this would carry the meaning ‘p and/or q’ (Gamut 1991:29). This use is thus inclusive as p can be true, q can be true but both p and q can also be true at the same time. In English, disjunction is expressed with the conjunction *or*. The English disjunctive however differs to that of the logical disjunctive because not only can it be used in an inclusive manner (example (1a)), but we often use it in an exclusive manner (example (1b)).

Inclusive use of *or*

(Thornton & Crain 2013:237)

- (1) a. Ted did not order pasta or sushi for lunch today
i.e. Ted did not order pasta and Ted did not order sushi.

- (1) b. You may order pasta or sushi
i.e. you can pick either pasta or sushi but not both

As we will see it is this difference that leads to the ambiguity of disjunctive questions in English.

1.3 Disjunctive interrogatives

Roelofsen and van Gool (2010) distinguish two categories of disjunctive interrogatives that differ in their surface syntactic form, namely *narrow scope* disjunctive questions and *wide scope* disjunctive questions. A narrow scope interrogative is a disjunctive question that is a ‘single interrogative clause, which contains a disjunction’ (Roelofsen & van Gool, 2010:1) (example 2a and 2b). Wide scope disjunctive questions are ‘two interrogative clauses conjoined by a disjunction’ (Roelofsen & van Gool, 2010:1) (example 2c).

- (2) a. Does Ann or Bill play the piano?
b. Does Ann love Bill or Chris?
c. Does Ann play the piano, or does Bill play the piano?

(Roelofsen & van Gool, 2010)

In this paper we will focus exclusively on narrow scope disjunctive questions because of their ambiguity. This ambiguity lies in the use of the disjunctive *or*, which as we explained in the previous section, can be inclusive or exclusive. In example 2c, which represents a wide-scope disjunctive question, we are asking if *either* Anne plays the piano *or* Bill. Here the speaker would expect an answer such as ‘Bill plays the piano/Anne plays the piano’. This is an example of the *exclusive* use of the disjunction and is defined as an *alternative question*. However when we look at the narrow-scope interrogatives in 2a and 2b, the disjunction can be interpreted as either inclusive or exclusive. If the disjunction is inclusive, then the speaker is asking the listener if at least one of the two people plays the piano, without demanding to know which person it is. This requires the listener to answer either *yes* or *no*. The inclusive use of the disjunction is therefore a polar question. The exclusive interpretation of the narrow scope disjunctive interrogative arises because it has the underlying syntactic structure of a wide-scope disjunctive interrogative, and is therefore defined as an *alternative question* (Han & Romero, 2004). Han and Romero state that narrow-scope *alternative* disjunctive questions

¹ Note this sentence can be either interpreted as inclusive or exclusive but for the purpose of this example we focus on the exclusive interpretation.

contain ellipsis of the second interrogative clause, which is common in other constructions in English that contain a conjunction and repeat the same information. If we look at the syntactic structure, we can see that the construction contains an ellipsis of the repeated information, as we have illustrated below in 3a and 3b.

- (3) a. [Would you like coffee] or [tea]? (Elliptical form)
 b. [Would you like coffee] or [would you like tea]? (Underlying form)

In short, an alternative narrow-scope interrogative has the underlying syntactic structure of two interrogative clauses separated by a disjunction, but it has the same surface structure as the polar narrow-scope disjunctive question (see Han & Romero (2004) for a more detailed account of the syntax of disjunctives). In examples 4a and 4b we have summarised the ambiguity of the disjunctive questions by showing their underlying syntactic structure and their answerhood conditions.

- (4) a. Would you like tea or coffee? (Alternative interpretation)
 [Would you like tea] or [coffee]? (Syntactic structure)
 Tea/Coffee (Felicitous set of answers)
 Yes/No # (Infelicitous set of answers)
- (4) b. Would you like tea or coffee? (Polar interpretation)
 Would you like [tea or coffee]? (Syntactic structure)
 Tea/Coffee (Infelicitous set of answers)
 Yes/No (Felicitous set of answers)

In summary, we are now faced with the case of syntactic ambiguity of disjunctive questions. This ambiguity is resolved through the use of prosodic features that typify either the alternative or polar interpretation. Roelofsen and Pruitt (2011:2) illustrate the relationship between prosodic realisations, syntactic representations and semantic interpretations and name three theoretical challenges namely:

1. To specify a grammar that generates a suitable range of syntactic representations
2. To specify how syntactic representations are mapped to semantic interpretations
3. To specify how syntactic representations are mapped to prosodic realisations

In this study we will focus on the third theoretical challenge. We aim to investigate the prosodic features that indicate the underlying syntactic structure, which therefore represent a separate semantic meaning. As we can see in this three-step approach, we do not assume a direct link between semantics and prosody, however many semanticists *have* attributed semantic functions to prosodic features directly. This suggests a link between semantics and prosody, a link that we will not assume to be direct. In the section 2 we will investigate the prosodic cues that typify both the polar and the alternative question. Furthermore we will examine how these cues represent the underlying syntactic structure of both questions.

2. Prosodic features of disjunctive questions

In section 1 we illustrated the semantic meanings and syntactic structures of both interpretations of disjunctive questions. In this section we will discuss the prosodic features that typify both the alternative, and the polar interpretation. We will focus on accentual characteristics, prosodic phrasing and the final contour.

2.1 Accents and Prosodic phrase boundaries

In this section we will investigate the manifestation of pitch accents in alternative questions and the absence thereof in polar questions. We argue that the pitch accent on the first disjunct of an alternative question coincides with the presence of a phrasal boundary, which signifies the underlying syntactic structure of two interrogatives conjoined by the disjunction.

The first point that we wish to address is that stress and accent are distinct from each other. There has been much confusion as to the distinction between stress and accent, and in many semantic articles on disjunctive questions, stress and accent are used interchangeably e.g. in Aloni & van Rooij (2002) and Han & Romero (2003) where they refer to stress on the disjuncts, but actually mean pitch accents. Gordon (2012) proposes that stress is realised on the lexical-level, while pitch accents are realised at phrasal level² (Gordon, 2002). Secondly, while fundamental frequency (F0) is the most important cue in the realisation of pitch accents, the realisation of stress on the lexical level is usually realised by ‘increased duration, greater intensity, and/or hyperarticulation’ (Gordon, 2012:11). Therefore we will use pitch analysis in this study and will use the definition of pitch accents of Steedman, who states that ‘Pitch accents are realized as maxima or minima in the pitch contour and coincide with the perceived major emphasis or emphases of the prosodic phrase’ (Steedman, 2000:653). Pitch accents have two primary functions in English, namely to convey semantic focus of important elements in the utterance (Gordon, 2012:3), and to signify the syntactic structure of a sentence when they coincide with prosodic phrase boundaries (Gibson & Watson, 2012).

As we just mentioned, the manifestation of pitch accents in the utterance is linked to the prosodic phrasing (ip or intermediate phrase) that makes up the intonation phrase (IP)³. In English a nuclear pitch accent is normally realised at the end of a prosodic phrase (Dainora,

² However this can sometimes be called ‘phrasal stress’ (Truckenbrodt (2012:132)). This is partially where the confusion arises.

³ In this study we will use the same framework as Krivocai (2007:2) who used (Beckman & Pierrehumbert, 1986) ‘Above the word, the two levels of prosodic phrasing in English are the Intonation Phrase (IP) and the Intermediate Phrase (ip). The IP is the largest unit and is defined as the domain of a coherent intonational contour that has a nuclear pitch accent, a phrase accent, and a boundary tone. IPs further branch into Intermediate Phrases (ip). The ip includes at least a nuclear pitch accent and a phrase accent. It further branches into words, which are in turn composed of syllables.’

2002) and ‘the general schema is for pitch accents and phrasal tones to be attracted to phrasal edges, presumably as a boundary signal to aid the listener in parsing an utterance’ (Gordon, 2012:20). In this study we will use Šafářová, Muller and Prévot’s (2005) definition of prosodic phrase boundaries:

1. Every completed turn boundary is a right edge IP boundary.
2. Phonologically, an IP boundary is often (i) indicated by a pause, (ii) accompanied by syllable lengthening of the preceding syllable, (iii) followed by pitch resetting and (iv) accompanied by a drop in amplitude.
3. An IP boundary often coincides with a major syntactic boundary (e.g., a finite clause boundary).
4. An information structure constituent (topic, focus) can be followed by an IP boundary.

(Šafářová, Muller and Prévot, 2005:3)

As we will see when we look more closely at the pitch contours of disjunctive questions, a typical characteristic of the alternative question is the presence of a pitch accent on the first disjunct which is followed by a prosodic phrase boundary. The semanticists’ focus has been to attribute a semantic function to this accent by defining it purely as a focus marker, however as Watson & Gibson (2004:174-175) postulate, pitch accents have a range of functions, which are also linked to syntactic information structure. Not only can pitch accents be used to highlight salient or new information (semantic function), but stressed elements also tend to mark the end of intonational phrases (Watson & Gibson, 2004:174-175). These intonational phrases are often used in language production and processing in order to disambiguate ambiguous sentences according to Watson and Gibson. Thus although these accents seem to have a semantic function, the presence of an accent and phrasal boundary may also be more closely linked to realising the underlying syntactic structure of the disjunctive question i.e. the inclusive or exclusive structure. Bartels (1999) states that the first disjunct of an alternative question, although normally followed by a prosodic phrase boundary, may not always be followed by a pause (Bartels, 1999:88). Intonational phrases however are not always separated by pauses according to Watson and Gibson, thus, in the case of alternative questions, we postulate that a possible function of the accented first disjunct may nevertheless be to signal the end of prosodic phrase, whether or not a pause occurs.

Although Watson and Gibson (2012:715) claim that the placement of phrasal boundary can be semantic or pragmatic in nature, they also claimed that the ‘syntactic structure plays a role in boundary placement and that these boundaries serve as cues to

differing syntactic structures' (Watson & Gibson, 2012:715). They illustrate the latter function of phrase boundaries using an example from a study of Snedeker & Trueswell (2003). In this study, speakers used prosodic boundaries as a cue to disambiguate the syntactically ambiguous sentence in (5) below. Speakers placed the phrase boundary after *tap* when *the flower* was part of the NP, and after *frog* when *the flower* was not part of the NP construction (Watson & Gibson, 2012:751)

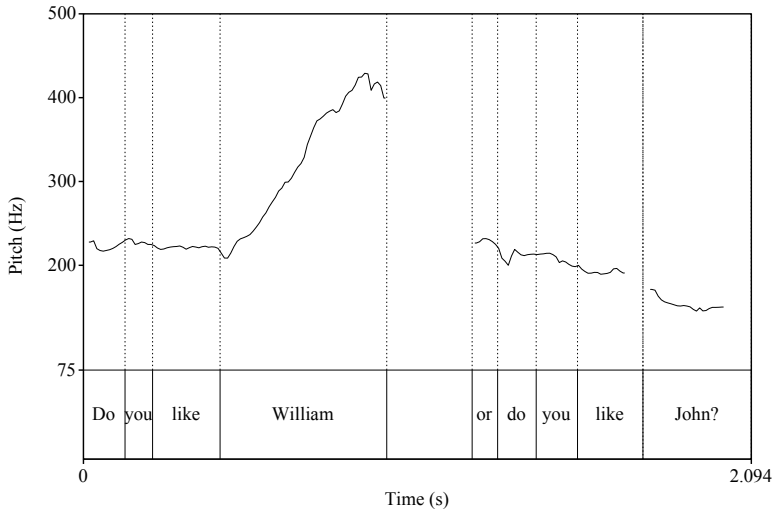
- (5) a. Tap [the frog with the flower] Snedeker & Trueswell (2003).
b. Tap [the frog] [with the flower]

Speakers thus used prosodic phrasing in order to group the words differently syntactically. Furthermore in Bögel's (2013) study of German case ambiguity between the dative and genitive case, speakers used phrasal boundaries and pauses in order to disambiguate the sentences.

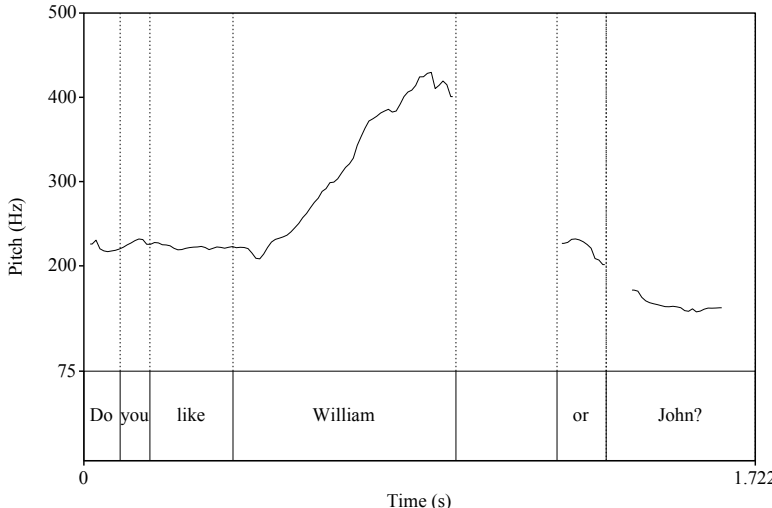
Now that we have argued that there is a possibly strong link between the pitch accent on the first disjunct of an alternative question and the presence of a prosodic phrase boundary, we will review what others have said about the presence of accents and a phrasal boundary in the literature on disjunctive questions. Bartels (1999), in her study of English intonation, examined a variety of different alternative questions and polar questions in order to explore the prosodic cues that must be present for an alternative interpretation. Bartels' hypothesis was that an alternative question must end in a final fall ($H^*L-(L\%)$), and that each of the disjuncts must be accented (Bartels, 1999:87). Bartels concludes that accents will not suffice as the only cue used in disambiguation, but that both final fall, and accents on the disjuncts should be present. Although Bartels characterised the alternative questions by the presence of a prosodic boundary after the first disjunct, she did not highlight the relationship between the presence of a prosodic boundary and the underlying syntactic structure.

While Bartels postulated that both accenting and final contour were needed in order to receive an alternative reading, a lot more work on the semantics of disjunctive questions has stressed the importance of the accenting on the disjuncts as being key to the interpretation of disjunctive questions (see Han & Romero (2003), Aloni & van Rooij (2002), Beck & Kim (2006)). According to Han and Romero the disjuncts are contrastively focused in alternative questions but not in polar disjunctive questions. Moreover they proposed that the accentual features in the alternative narrow scope disjunctive question were realised identically to the semantically identical wide scope disjunctive question without ellipsis. This proves an interesting idea and we would like to illustrate this important point by showing the pitch

contours of an alternative question without ellipsis, and the same question where the repeated information has been spliced out. This results in a narrow scope interrogative.



Pitch Contour 2.1.i The F0 of a wide scope interrogative



Pitch contour 2.1.ii The F0 of a wide scope interrogative with ellipsis

As we discussed in section 1.2, disjunctive alternative questions involve the ellipsis of the second interrogative clause, which is conjoined by the disjunction *or*. What we are left with is a second disjunct. In the wide-scope disjunctive question (Pitch contour 2.1.i) that contains no ellipsis, we see the same accentual features on the disjuncts as we would in a narrow-scope alternative question i.e. a high rise in F0 on the first disjunct and a lower F0 on the second disjunct. In the wide-scope disjunctive question, we observe a prosodic phrase break after the first interrogative clause, signifying the presence of a syntactic boundary, where two separate interrogative clauses are conjoined by the disjunction. Han and Romero however characterised this as a case of focus marking. We propose that the combination of accent and

phrase boundary is not directly a focus marker, but indicates that the second disjunct is in a separate interrogative clause, which would be present if the second construction was not elliptical. We argue that the first disjunct is accented because of its final position in the prosodic phrase however we do acknowledge that, because the alternative question syntactically contains two interrogative clauses conjoined by the disjunction, the disjuncts may be inherently accented because of their position in their own separate interrogative clause i.e. they are both in the nuclear accent position.

Pruitt (2008) was the first to test the influence of prosodic cues on the interpretation of disjunctive questions. Pruitt conducted a listening experiment in order to test the two hypotheses that we mentioned above i.e. that accentual characteristics were the most important cue versus Bartels' claim that both accenting and final contour were needed. In order to do this, Pruitt manipulated the final contour of polar questions and alternative questions. This created two sets of minimal pairs that differed with respect to one of the cues. In the first set both questions included accents on the disjuncts but differed in their final contour, the second set included questions that had no accenting on the disjuncts and also differed by having either a rising contour or a falling contour. She found that final contour was the most salient cue used in disambiguation, but that accenting slightly increased the likelihood of an alternative interpretation (Pruitt 2008:7). Pruitt also concluded that accenting alone could not disambiguate the questions, contrary to the semantic focus models. Again like the other work that we have mentioned in this section, Pruitt did not highlight the relationship between the prosodic phrase boundary and the underlying syntactic structure. Moreover, Pruitt only tested interrogatives in which the final disjunct coincided with the final contour, she therefore did not control that the manipulation of the final contour did not change the realisation of accent on the second disjunct.

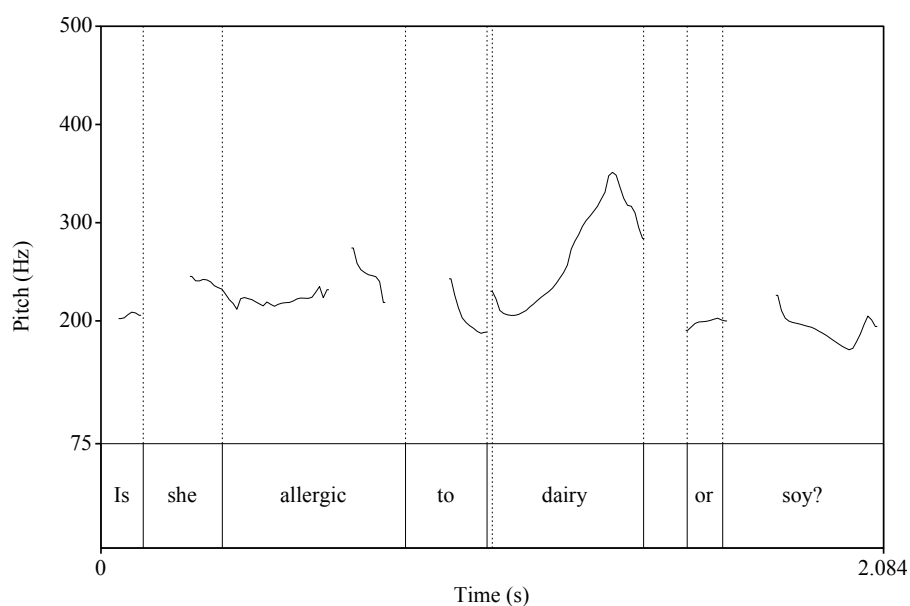
In light of the literature that we have presented in this section, we will now look at the manifestation of prosodic features in disjunctive questions which we recorded from a female native English speaker. The speaker was instructed to ask the questions in both a polar and alternative manner. She repeated these multiple times in order to achieve a more natural recording.⁴ For this study we chose to use two syntactic structures of disjunctive question in order to ensure that the final disjunct did not always fall in final position of the question, which would coincide with the final contour. Thus in order to investigate the accenting patterns independent of the influence of final contour on the accent of the second disjunct, the

⁴ Corpus files including disjunctive questions could not be found, however in the future this would be a more reliable option for analysis as forced-recordings are often the most often prototypically realised. Secondly we acknowledge that placing the sentences in a text for example may have been better in order to elicit a more natural recording.

first set of questions, which we will refer to as SYNTAX 1 contained question-final disjuncts. The second set of questions contained disjuncts that were placed before the end of the question, henceforth SYNTAX 2.

2.1.1 Pitch contours Syntax 1

In this section we will look more closely at the manifestation of prosodic cues in the pitch contours below. The following two pitch contours are examples of an alternative and polar question, in which the disjuncts fall in the final position of the question. In the first pitch contour (2.1.1i), which depicts the alternative question, we can clearly see the presence of a pitch accent H* on the first disjunct, *dairy*, which is followed by an L% boundary tone. Furthermore we note the presence of a pause after this boundary tone. As we explained in section 2.1, not all phrase boundaries are followed by a pause (Gordon (2012), Watson & Gibson (2012)), however they are normally be followed by a pitch reset. We can see the resetting of the pitch from the drop in pitch on the disjunction *or* in the pitch contour below.

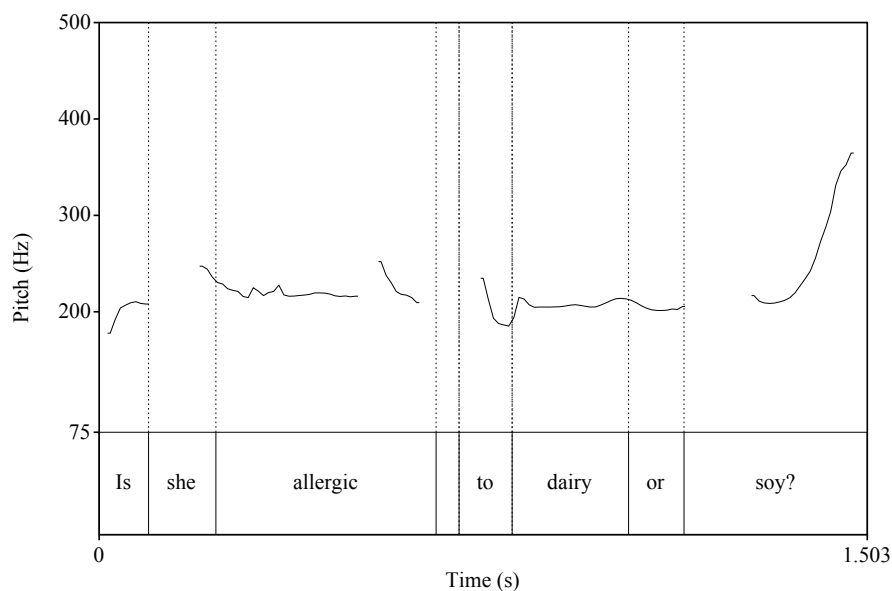


Pitch contour 2.1.1i: Alternative question syntax 1

Finally in pitch contour 2.1.1.i we can see the L* accent on the second disjunct *soy* and the final contour, which is falling. Moreover, we note the similarity in characteristics in the F0 contour in 2.1.1i as that in 2.1ii above, which depicted a wide-scope interrogative in which the second interrogative clause was spliced out. Again, this is further evidence for the use of accenting and phrasal boundary placement in order to signify underlying syntactic structure.

Pitch contour 2.1.1.ii represents a polar question of syntax 1, which is identical in its wording to the alternative question above. In contrast to the alternative question contour, the

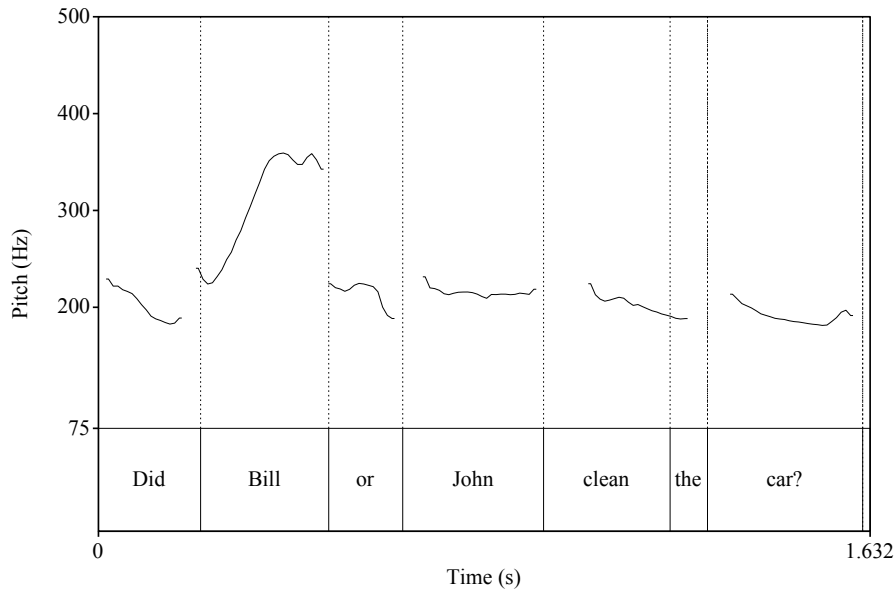
disjuncts are pronounced in one prosodic phrase. As we can see the contour of the first disjunct shows no sign of an accenting, which would be realised as a rise or noticeable fall in the F0; this contour is flat. Moreover we see no boundary tone after the first disjunct and the pitch level is not reset but remains the same. Finally we note the characteristic rise of the final contour on the last disjunct *soy*.



Pitch contour 2.1.1ii: Polar question syntax 1

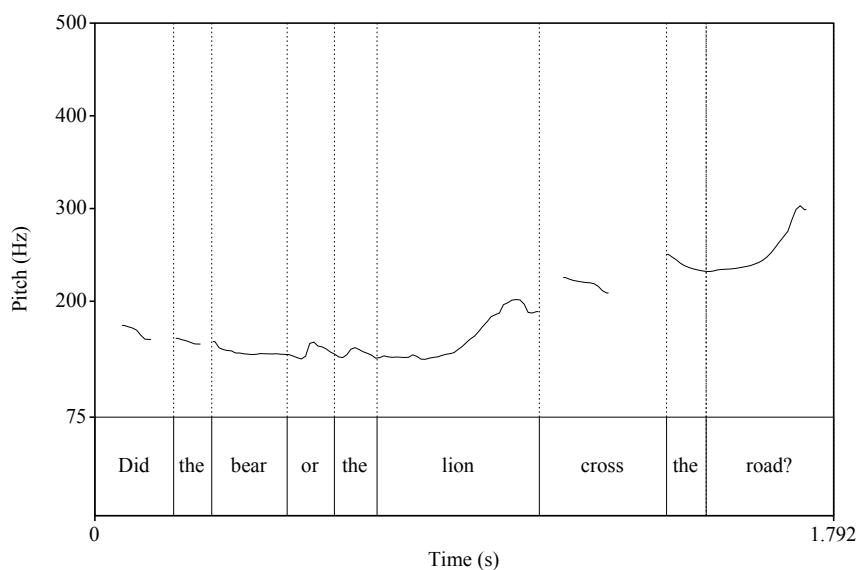
2.1.2 Pitch contours Syntax 2

In this section we will look closely at the prosodic features of the disjunctive questions when the disjuncts do not fall in question-final position. As we mentioned, this ensures that the information on the disjuncts is not altered by the presence of the final rise or fall. Pitch contour 2.1.2i depicts the alternative disjunctive question. Note here, that the accenting on the first disjunct shows the same pattern as that of syntax 1. Furthermore it is followed by a boundary tone, the presence of a pause and the resetting of the pitch level on the disjunction *or*. Secondly the second disjunct has a much lower fundamental frequency in contrast with that of the first. This alternative question, like that of syntax one, ends in a final fall.



Pitch contour 2.1.2 i Alternative Question syntax 2

In pitch contour 2.1.2ii, which shows the polar question with non-final disjuncts, we again, like in the polar question of syntax one, do not observe any accent on the first disjunct. In the polar question there is no phrasal boundary after the first disjunct, and the disjuncts are again realised in one continuous prosodic phrase. Interestingly we see that the second disjunct is accented and also ends in a low boundary tone marking the end of an intermediate phrase. This is noteworthy because in most semantic accounts of disjunctive phrases the accents on the disjuncts have been attributed to alternative questions. Moreover their function was postulated to be a marker of focus, however in this polar question we can see that the second disjunct is not focused semantically, but ends in a boundary tone. This gives further evidence that accents do not exclusively act as focus markers, but can be present because they coincide with a phrasal boundary that conventionally includes a nuclear accented word.



Pitch contour (iv) Polar Question non-final disjuncts

From our analysis of the manifestation of accents and phrasal boundaries, we conclude that the presence of an accent on the disjunct is not automatically a semantic focus marker, but also coincides with a phrasal boundary that in turn signals the underlying syntactic structure of the exclusive disjunction. In this section we briefly described the final contour of the polar and alternative question. In section 2.2 we will look more closely at the realisation of the final contour and its importance as a cue used in disambiguation.

2.2 Final Contour

As we noted in section 2.1, a rather small amount of work on disjunctive questions has considered the final contour to be an important feature of disambiguation. However from Pruitt's experimental results, she postulated that the final contour was the most salient cue used in the disambiguation of disjunctive questions (Pruitt, 2007). She found that a rising final contour was needed in order to receive a polar interpretation, and that a falling final contour was essential for the alternative interpretation. This observation conformed to Bartels' (1999) classification of disjunctive questions. In Pruitt's collaborative work with Roelofsen (see Roelofsen & Pruitt, 2013) they took the final contour as the central cue used in the semantic model. They postulated that the final fall signifies closure of options in alternative questions i.e. that the speaker is sure that one of the disjuncts which they have given, must be the case (Roelofsen & Pruitt (2013:24)⁵. This again is closely tied to Bartels'

⁵ However in the final version they concluded that both accents and final fall were important and would have to be accounted for in a semantic model.

work, where she claimed that the final fall of alternative questions signifies an assertion morpheme i.e. that the speaker is sure that one of the options is true.

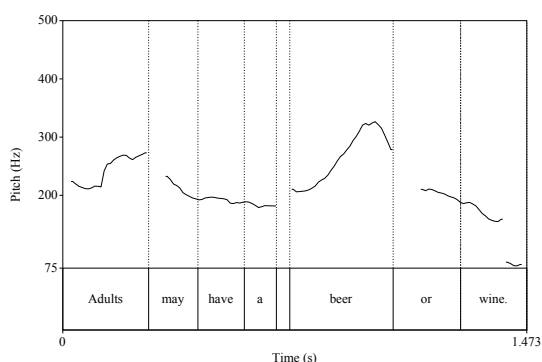
We will argue that the accentual features that coincide with the presence of a phrase boundary in the alternative question, are the most important feature that define the nature of the disjunction. In order to illustrate this, we will look at the prosodic characteristics of alternative declaratives in section 2.2.1. We will additionally argue that the choice of final contour must always coincide with a certain pattern of accentual characteristics and the presence or absence of a prosodic boundary. Here we hypothesise that the presence of the accenting and phrase boundary in the alternative question, and lack thereof in the polar question trigger either the final rise or fall. Furthermore we will stress the inclusion of multiple prosodic features in any semantic model that wishes to give a realistic account of how speakers disambiguate disjunctive questions. In order to illustrate this point, we will look at the realisation of accentual features and the presence of a prosodic boundary in disjunctive declaratives.

2.2.1 Alternative Declaratives

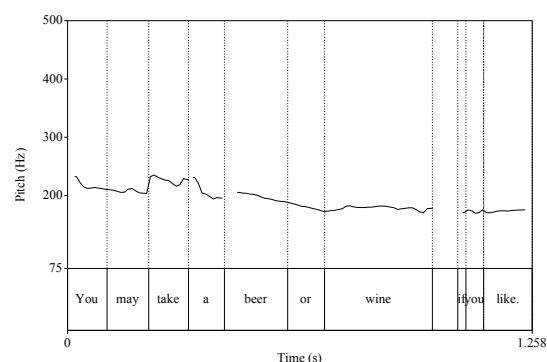
One of the shortcomings of the literature on disjunctive questions is that little attention has been spent on disjunctive declaratives, which may contain potential evidence of the importance of accenting and prosodic phrase boundaries. One of the key reasons why disjunctive questions have proven a topic of interest in semantics is because of their ambiguity. However if we look more closely at their declarative counterpart, we also see the exact same ambiguity. This ambiguity arises from the two functions of the disjunction *or*, which we elaborated on in section 1.2.

The question now arises if the accentual cues and placement of a prosodic phrase boundary, which we find in alternative disjunctive questions, are present in exclusive disjunctive declaratives. If so, we will argue that the presence of a prosodic phrase boundary between the disjuncts, and the accentual characteristics on each disjunct are the most important cues in the interpretation of exclusivity of the disjunction. In order to illustrate the prosodic similarities between declaratives and interrogatives we will show the F0 contours of two declarative disjunctive sentences. The first contour 2.3i depicts the use of the exclusive disjunction. As we can see, the exclusive reading disjunctive declarative and its counterpart, the alternative interrogative, have the exact same accenting patterns, and also include a prosodic phrase boundary after the first disjunct. Pitch contour 2.3ii depicts that of an inclusive disjunctive interrogative. Here we see that the disjuncts are realised in one syntactic

phrase. The inclusive declarative shows no accenting on the disjuncts and a lack of phrase boundary, which is nearly identical to the pitch contour of its polar interrogative counterpart.



Pitch contour 2.3i Disjunctive declarative
(exclusive)



Pitch contour 2.3ii Disjunctive declarative
(inclusive)

This interesting parallel between disjunctive declaratives and interrogatives provides evidence that the prosodic phrasing and accentual characteristics are the most important cues in interpreting the nature of the disjunction. The placement of the boundary in the alternative interrogative, and in exclusive declarative represents the underlying syntactic structure, which contains two clauses conjoined by the disjunctive. The second interrogative clause is normally not realised (as in many other examples in English where two phrases with identical wording are conjoined), however the use of prosodic phrasing signals that there is an ellipsis of information. For now, we conclude that leaving the accentual characteristics and presence of a prosodic phrase boundary out of a semantic model will not be sufficient if one wishes to give a phonetically accurate account of the disambiguation of disjunctive questions.

2.2.2 *The relationship between final contour and the nature of the disjunction*

As we have just illustrated, accentual characteristics and the presence of a prosodic boundary are important features in the disambiguation of disjunctive declaratives. Declaratives nevertheless differ from interrogatives with respect to their final contour. As we explained, the inclusive use of the disjunction leads to a polar question, which contains a final rise, in contrast, the exclusive use of the disjunction in a question leads to a final fall (Bartels (1999), Pruitt (2007)). We contend that the accents and placement of a prosodic boundary between the disjuncts distinguishes the exclusive disjunction from the inclusive disjunction. Based on the nature of the disjunction, the result is an alternative question or a polar question. The

choice of final boundary will then conform to the norms of English interrogative final contours as stated by Gordon (2012) below:

Yes/no questions in English characteristically are realized with a final rise in pitch, thereby distinguishing them intonationally from declaratives and wh-questions. The large prosodic units characterizing coherent semantic constituents such as declaratives and questions are typically termed ‘Intonational Phrases’ or ‘Intonation Units’.
Gordon (2012:3)

Thus the polar question will typically end in a final rise and the alternative question, like other unmarked interrogatives will end in a final fall. We conclude from our analysis thus far that both cues are crucial for the disambiguation of disjunctive questions. In order to test this hypothesis we will need experimental evidence that shows that accentual characteristics are important in the disambiguation of disjunctive questions, but we will also need to examine the effect of the addition of an artificial prosodic phrase break. In section three we will test this by conducting a forced-choice listening task.

3. The Present Study

3.1 Accentual characteristics vs. Final Contour

In order to investigate the hypothesis that accentual characteristics are indeed salient, we will conduct an experiment similar to that of Pruitt (2007). Roelofsen and Pruitt's (2013) paper investigated the influence of the final contour and accentual characteristics on the interpretation of disjunctive questions. They concluded that the final contour was the most salient cue, rejecting the hypothesis of Aloni and van Rooij (2004). Aloni and van Rooij postulated that the accentual characteristics on the disjuncts were the most important. As we mentioned in section 2.2, Roelofsen and Pruitt only tested stimuli in which the final disjuncts were placed at the end of the question. This meant that the final contour fell on the final disjunct. This inevitably means that we cannot conclude that the final contour is the most decisive cue based on Pruitt's experimental evidence.

In order to test whether it is indeed the final contour that is most salient we will use two different syntactic structures. One of these structures consists of the disjuncts in NON-FINAL position, and the second syntactic structure consists of disjuncts that like in Roelofsen and Pruitt's experiment, will fall in (FINAL position). By doing this we will make a definite distinction between information on the disjuncts and information held in the final intonation contour. Our first research question therefore concerns the effect of final contour and accenting on the interpretation of disjunctive questions when the disjuncts are non-final versus when the disjuncts fall in the final position of the question.

If the final contour is the most salient cue, then we expect that for both syntactic structures a final rise will result in a POLAR interpretation and a final fall in an ALTERNATIVE interpretation. However if the accentual cues are salient then we expect that prototypical alternative accentual cues on the disjuncts will result in an alternative interpretation even in the presence of a final rise..

3.2 The Effect of Pause Insertion

In section 2, we hypothesised that the presence of accenting on the first disjunct was linked to the presence of a prosodic boundary that is present in the alternative question. The realisation of two separate prosodic phrases in the alternative question is thus thought to represent the underlying syntactic structure, which differs from that of the polar question. In order to test this hypothesis, we will investigate the effect of a prosodic phrase boundary. Because the end of a prosodic phrase is usually followed by a pause or break in the F0 signal (Watson &

Gibson, 2012:714), we will investigate the effect of a prosodic boundary by inserting a pause of 270 ms after the first disjunct. By doing this we hope to create the illusion of a phrase boundary. Our second research question is thus ‘Does the addition of a pause of 270 ms increase the likelihood of an alternative interpretation when the final contour is rising?’

If the insertion of a pause of 270ms is a salient cue, then the presence of the pause between the first disjunct and the disjunction should result in an alternative interpretation or should increase the likelihood of an alternative question. We do however stress that a simple break of 270ms may not be enough to signal a prosodic phrase boundary, which is, as we explained in section 2.1, also characterised by a final pitch accent and a boundary tone. This means that when a pause is inserted in the polar questions, critical prosodic cues that are linked to the boundaries, will not be present.

4. Design

For this experiment we used 6 simple disjunctive questions (see example (6a)). This meant that the disjuncts consisted of one noun or proper name, and not a larger syntactic phrase. Unlike Roelofsen and Pruitt (2013), who used more complex disjunctive questions, like that in example (6b), we purposely wanted to keep the questions simple to avoid undesirable prosodic effects that a larger NP or VP might cause.

- (6) a. Does Ben speak English or French?
b. Did the professor ask Bill to come early or stay late? (Roelofsen & Pruitt 2013)
c. Was the baby a boy or a girl? (Adaptation of Beck and Kim 2006:165)
d. Did John or Bill pick up the mail?

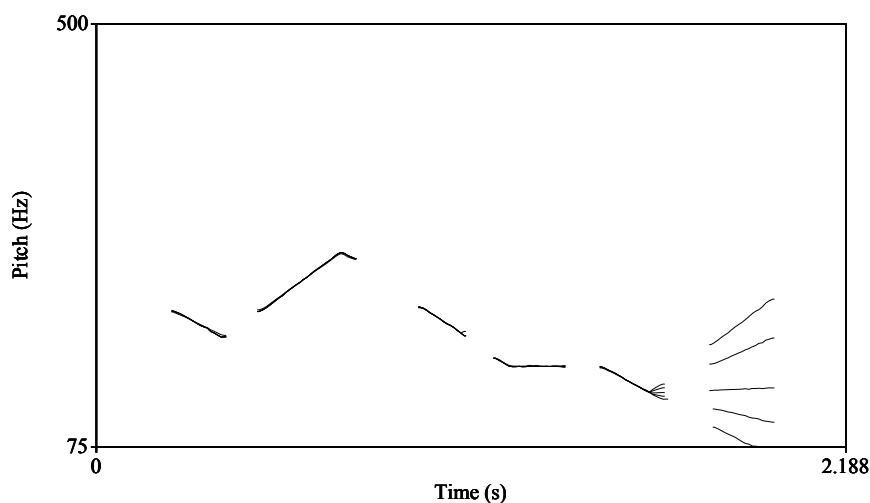
Secondly the choice of questions was based on simultaneous plausibility i.e. both disjuncts must be able to be true at the same time. In example (6a) it is possible that Ben speaks English only, French only, both or neither. Therefore both a yes/no and an alternative interpretation are possible. In (6c), only an alternative reading would be possible, and therefore a yes/no interpretation would never be felicitous as being both male and female simultaneously is impossible. Roelofsen and Pruitt did not use this as a criterion and therefore did not ensure that the semantic meaning would not outweigh the phonetic cues.

Finally we decided to include questions that differed syntactically from each other to ensure that in at least 50% of our stimuli the final disjuncts did not coincide with the final contour, as it did in Roelofsen and Pruitt's experiment. The first form consisted of a disjunct-final disjunctive phrase (example 6a) and the second type consisted of a non-final disjunctive phrase (example 6d).

In order to create the stimuli a native English speaker was recorded asking the 6 disjunctive questions (see appendix 1) as a polar question and as an alternative question in a soundproof room. Because the yes/no question in particular has a lot of coarticulation and lack of phrasal boundary when spoken naturally, this had to be avoided in order to manipulate the questions at a later stage. This meant that the polar questions did contain a short pause, which was removed during manipulation in order to re-join the two prosodic phrases into one. The use of both a polar and alternative question ensured that the prosodic features on the disjuncts did not have to be artificially simulated, which created more natural stimuli.

The final contour was then manipulated in five equal steps of 40Hz, creating a continuum from a falling to rising contour for each of the twelve sentences. This resulted in 60 different

questions. In order to manipulate the pitch we shaped the final contour individually for each question in Praat (Boersma & Weenink, 2014) with the ‘stylise pitch function’. This meant that for each sentence the value of the highest rise or lowest fall had a different F0 value in hertz. While Roelofsen and Pruitt used the splicing method (ensuring that the rise for every sentence was the same) we found that using the same value, for example 300Hz for the highest rising contour, led to unnatural sounding stimuli. In order to create the continuum we started with the most neutral contour, which was flat (in graphic 4i illustrates an example of the manipulation of the final contour). We then manipulated the pitch two steps above the most neutral contour and two steps below by 40Hz per step. We chose 40Hz because the average falling contour of the alternative question in our recordings was approximately 180Hz and the average rise of the polar question was approximately 300Hz. We took the difference between the highest and lowest contour and divided by three in order to ensure that the steps would be equal. Therefore in order to create three more equal steps between them, we moved in steps of 40Hz. This resulted in a continuum as shown below in graph 4i. The use of a continuum also ensured that the rising or falling contour was not always the most prototypical rise or fall.



Graphic 4.1(i): example of a manipulated continuum 60Hz – 220 Hz in steps of 40 Hz

Finally the pause between both disjuncts was manipulated for each of the twelve questions and their five pitch variations. This resulted in two possible variants of each question: pause or no pause. We chose the duration of the pause based on experimental evidence on the threshold for the perception of pauses, which lies between 200 and 250ms (Zelner, 1994:44). We chose a value of 270ms to lie just outside of this threshold. The pause was inserted after the first disjunct where we would expect a prosodic phrase boundary in an alternative question. Again, the purpose of the pause was to give the illusion of a phrase boundary in the

polar questions and to accentuate the boundary in the alternative questions. Below we can see the effect of pause insertion in a polar question. Graph (i) shows the original stimulus without the pause and graph (ii) the stimulus after the insertion of a pause.

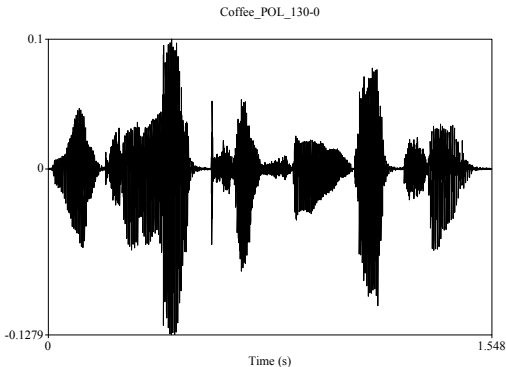


Figure 4.ii.a Polar question syntax 1 without pause

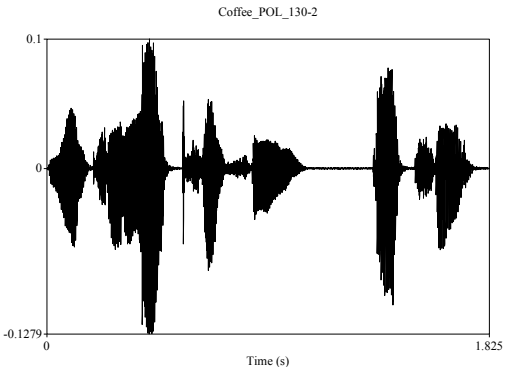


Figure 4.ii.b Identical polar question after insertion of pause

In total we created 120 stimuli, however for the final task we decided to reduce the number of stimuli to 65. Testing too many stimuli would have resulted in a ‘boring’ test, which would have included too much repetition. The final test consisted of 8 continua, which we have illustrated in matrix 4.1.ii below. Each continuum was made up of a selection of the 120 stimuli. The choice of stimuli was random but each level of the continuum had to be represented. In addition to these 40 target questions, a further random choice of the 120 stimuli were added as fillers, and a further 5 controls were added. The 5 controls were un-manipulated polar and alternative questions. The purpose of the controls was to ensure that participants understood the difference between the polar and alternative question when spoken naturally.

	Polar question Syntax 1		Alternative question Syntax 1		Polar question Syntax 2		Alternative question Syntax 2	
Pause → Contour ↓	0 ms	270 ms	0 ms	270 ms	0 ms	270 ms	0 ms	270 ms
Falling*								
Falling-								
Neutral								
Rising-								
Rising*								

Table 4.1.iii Matrix depicting all 40 target stimuli and their characteristics (* = highest rise/fall, - = medium high)

4.1 Participants

20 native speakers of English between the ages of 17 and 49 years partook in the study. In total 8 female and 12 male participants were tested of which none reported any language impairments or hearing difficulties. In total we tested 8 British English speakers, 3 South African English, 2 Australian English speakers and 7 American English speakers. Irish and Scottish English speakers were purposely excluded because of the rising pitch phenomenon that is found in declaratives in these varieties of English. Finally none of the participants were linguistics students.

4.2 Task

Each participant took part in a forced-choice felicity task. The participants heard a total of 65 stimuli of which 40 target stimuli, 20 fillers and reduplications, and 5 control stimuli, which contained no manipulations. The task was performed in a silent room, and each participant was tested separately using headphones. Unlike Pruitt (2007) who gave the participants a choice of two paraphrases, the participants were asked to perform a felicity-choice task. After hearing one of the stimuli, two sets of answers appeared on the screen, an option containing yes/no and an option containing the disjuncts that were heard in the stimulus, for example dairy/soy. The yes/no option denoted a polar interpretation, and the disjuncts, an alternative interpretation. This ensured, keeping with the formal semantic analysis of questions, that the interpretation would be defined by the set of possible answers as described in section 1.3. Each participant was presented with the same set of stimuli, however the order was changed for each test. Secondly, the two possible sets of answers appeared on screen *after* the stimulus had been played to ensure that participants heard the entire question before answering. The participants were given minimal information about the nature of the test and were told to choose the set of answers that they found the most appropriate for the question they heard.

5. Results

5.1 Binary Logistic Regression

In order to analyse the effect of the independent variables, we performed a binomial logistic regression in R Studio using the `glmer` function (R development team, 2014). This form of analysis was the most suitable for two reasons:

1. The dependent variable was binary: alternative vs. polar interpretation
2. Binomial logistic regression allows for both continuous and categorical independent variables.

For this analysis, we did not treat syntax as an independent variable in our model, but decided to compare the effects of our independent variables on the interpretation in both syntactic forms separately. This ensured that the possible interaction between the final contour and the accenting of the final disjunct in syntax 1 would not affect the results when they were independent of each other, as in syntax 2. Our first research question concerned the effect of the accentual characteristics and the final contour on the interpretation of the questions. For this research question we did not include the stimuli that included the variable PAUSE. For the second research question we included all three of our independent variables, including the stimuli that included a pause of 270ms. Again here, we analysed syntax 1 and syntax 2 separately. Finally we constructed a model separately for syntax 1 and 2 that included all of independent variables and their interaction with each other. Each variable was coded with dummy codes. The dependent variable was coded as 1 or 0 (1=ALT interpretation and 0=POL interpretation). Secondly the independent variables were coded in the same way:

IV 1: Accenting: 1= alternative accenting; 0= no accenting (polar accenting)

IV2: Final contour: +2=High, +1=Medium High, 0=Neutral, -1=Medium Low and -2=Low

The results of the binary logistic regression analysis for both questions are reported in section 5.1.1 and 5.1.2.

5.1.1 Results syntax 1 and 2: The effect of final contour and accenting

As we can see from our results in table 5.1.1, both final contour and accentual characteristics are both statistically significant predictors of interpretation, which are needed to disambiguate the alternative reading from the polar reading. The presence of accenting leads to an alternative question, and a falling final contour increases the likelihood of an alternative question.

	Predictor	Coefficient	Std. Error	Wald Z	<i>p</i>
Syntax 1	FC	1.4195	0.2078	6.832	<0.001
Syntax 2		0.4787	0.1381	3.466	<0.001
Syntax 1	Accent	3.0951	0.5276	5.866	<0.001
Syntax 2		2.9790	0.3923	5.786	<0.001

Table 5.1.1. The effect of Final Contour (FC) and accentual characteristics on the interpretation of syntax 1 and syntax 2

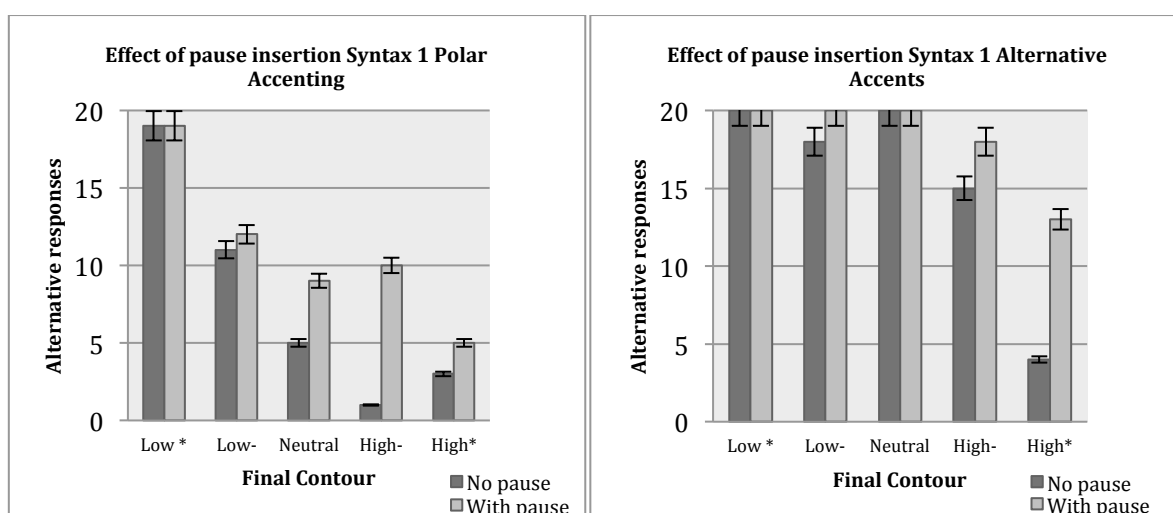
Although in the table above, the coefficient of the final contour is lower than that of the accentual characteristics for both syntax 1 and syntax 2, we would like to note that this is the coefficient for each of the five levels of final contour. Thus the coefficient from the lowest final contour to the highest is four times the coefficient in the table. The coefficient for the difference from the lowest to highest contour is therefore 5.678 for syntax 1 and 1.9148 for syntax 2. Final contour thus was found, however, to have a larger coefficient in syntax 1, as Pruitt (2007) also observed. But as we mentioned in section 3, manipulating the final contour may too have manipulated the accentual features of the second disjunct, which was also in the final position. Therefore by looking at syntax 1 alone we cannot postulate that final contour is the most important cue. Like Pruitt, we also found that accentual characteristics were statistically significant as a predictor.

In order to keep the accentual characteristics of the disjuncts apart from the final contour we also tested syntax 2, which consisted of non-final disjuncts. Interestingly the same results were not obtained when the disjuncts were in non-final position. Using the same method as for syntax 1, we found that accentual characteristics on the disjuncts had a larger coefficient than final. If we look at table 5.1.1 we see a large difference in the effect of final contour between syntax 1 and syntax 2. In both cases however it was statistically significant.

From these results we cannot conclude that one of the cues is more salient than the other. In syntax 1, final contour had a larger coefficient than that of the presence of accents on the disjuncts. In syntax 2, we found the opposite trend, which showed that accentual characteristics were the strongest cue. For now we conclude that both characteristics are salient and needed in any semantic model that attempts to formalise the semantics of disjunction.⁶ Moreover we can reject Pruitt's hypothesis that the final contour is always the most important cue, and that accentual features alone cannot lead to an alternative interpretation. In the discussion we will elaborate further on this point.

5.1.2 The effect of pause insertion

In order to look at the effect of the phrasal boundary between the disjuncts, we included a pause of 270ms between the first disjunct and the disjunction. We found that this cue had a statistically significant effect on the number of alternative questions for both syntactic structures, but that accent and final contour contained the largest coefficients. When we compare the instances of questions with and without pause insertion, we can see that in nearly all instances and for all levels of final contour, pause insertion led to an increase in alternative interpretations. Furthermore in tables 5.3, we can see a significant increase in alternative answers when a pause was inserted, even when no accents were placed on the disjuncts (polar accenting) and when the final contour was rising. The statistically significant effect of pause insertion leads to more evidence that the presence of a prosodic boundary is a crucial feature, that is used in the disambiguation of disjunctive questions.



⁶ In the later and final version of Roelofsen and Pruitt (2013) they reach the same conclusion however we did not see this until after this paper was written.

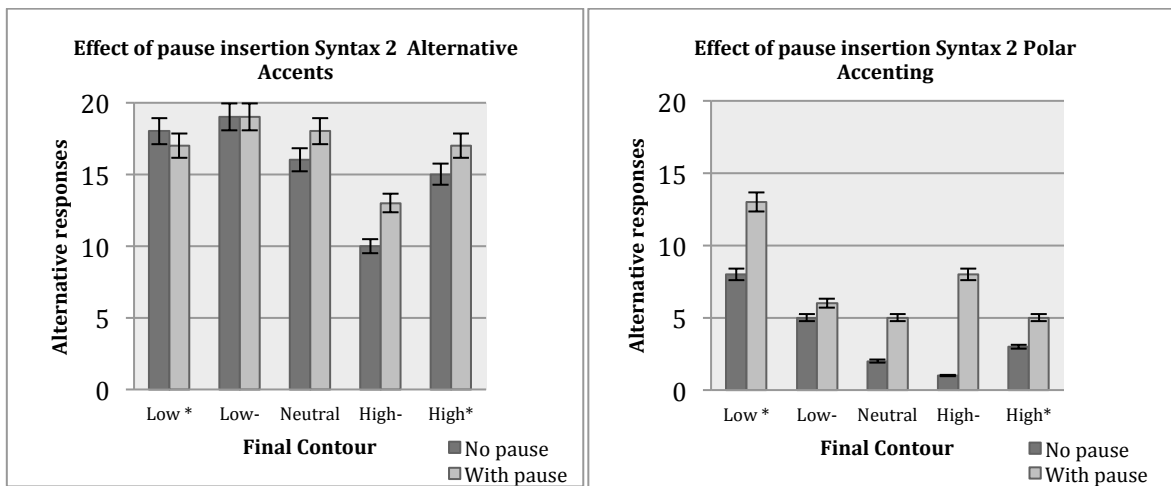


Table 5.3.i: Charts show the amount of alternative responses for each syntactic structure, the accentual characteristics before and after the insertion of a pause with a 95% confidence interval.

In the table below, we have developed a model using R in which all three independent variables are taken into account, including their interactions. In syntax 1, like in Pruitt's results we see that final contour remains the most significant independent variable. Furthermore accent remains highly significant with pause insertion having the lowest effect. However in syntax 2, final contour has a considerably lower effect on the choice interpretation of the question, significantly lower than the presence of a pause.

	Predictor	Coefficient	Std. Error	Wald Z	p
Syntax 1	FC	1.2686	0.2478	5.119	<0.001
Syntax 2		0.49106	0.20228	2.428	<0.05
Syntax 1	Accent	3.3190	0.6135	5.410	<0.001
Syntax 2		2.98050	0.39298	7.584	<0.001
Syntax 1	Pause	0.9504	0.3686	2.578	<0.01
Syntax 2		1.03844	0.35836	2.898	<0.01
Syntax 1	FCxPause	0.5943	0.2999	1.982	<0.05
Syntax 2		0.18245	0.25338	0.720	>0.05

Table 5.1.2 The complete logistic regression model including all independent variables

We therefore conclude from these results that the placement of a prosodic boundary, has a much more significant impact on the interpretation than has been postulated in the literature of disjunctive questions. Furthermore, this gives more evidence that accents on the first

disjunct coincide with phrasal boundaries, rather than being defined as focus markers. Finally, in the case of syntax 2, we can see that final contour had a significantly lower effect on the choice of alternative interpretation than in Pruitt (2007).

6. Discussion

As we have observed from the results above, we cannot conclude that one cue is more salient than the other. In the case of the FINAL disjuncts structure (syntax 1), the final contour was statistically the most salient cue. In the case of syntactic structure 2, which contained NON-FINAL disjuncts, the accentual characteristics were statistically the most decisive having larger coefficients. We therefore conclude that the accentual characteristics do have a more significant role than first stated by Roelofsen & Pruitt (2013)⁷. Secondly both accenting and final contour are statistically significant predictors of interpretation. Any semantic model that characterises the prosodic factors necessary in disambiguation, must take both cues into consideration. We will return to the interaction between accent and final contour in section 6.2. In section 6.1 we would like to focus on the notion of accents as focus markers, and further clarify that these accents may not serve a purely semantic focusing function.

6.1 Accents and Prosodic Phrases

As we mentioned above, describing the accent on the first disjunct as a focus marker will not give a sufficient phonetic classification of the function of the rise in F0. We would like to emphasise that accents serve a much wider function in the case of English prosody. Watson and Gibson (2004), in their study, illustrated the use of prosodic factors to show underlying syntactic structures. They stated that not only do accents serve a function to convey focus, but they also serve to ‘signal underlying syntactic structure in syntactically ambiguous sentences’ (Watson & Gibson, 2004:2). Their syntactic function arises from the interaction they have with phrasal boundaries. In the case of disjunctive questions and declaratives, we saw that the alternative or exclusive use of the disjunction included a high accent on the first disjunct. The second disjunct contained a low pitch accent. Fógady and Bernard (2006:715) described this difference in accent manifestation as tonal polarisation, whereby the first disjunct contained a rise in F0, and the second disjunct a contrastively low F0. The contrastive manifestation of the accents on the disjuncts was said to show that the disjuncts were exclusive from each other. However in the exclusive interpretation, we also observe a prosodic phrase boundary between the first disjunct and the disjunction. We argue that a prosodic phrase boundary is obligatory, but we postulate that this prosodic phrase boundary is not always followed by a pause or visible break in the prosodic signal. We conclude this in light of Watson and Gibson’s observation that ending a prosodic phrase does not always result in pause at the end or visible break in the F0 signal. (Watson & Gibson, 2004).

⁷ Again this was stated in their unpublished manuscript and in the initial works of Pruitt (Pruitt (2007))

This leads to the conclusion that the accent on the first disjunct may actually indicate the end of a prosodic phrase, and therefore illustrate the underlying syntactic structure of the alternative narrow scope interrogative. This argument is also strengthened by the statistically significant effect of pause insertion, which served to emphasise a prosodic phrase boundary. We observed that even in the absence of accenting and a boundary tone, the insertion of a pause was statistically significant, and led to an increase in alternative interpretations. Moreover, the disjuncts may be accented because they both fall in the nuclear accent position in their underlying separate interrogative clauses. Roelofsen stated that it is the underlying syntactic forms, which lead to different semantic interpretations. Our analysis thus illustrated the interaction between syntax and prosody without assuming a direct link between semantics and prosody. This contrasts with the characterisation of pitch accents as semantic focus markers, which treats tones as compositional phoneme-like entities. Moreover the use of morpheme like classification of tones, for example as focus markers and assertion markers, assumes a direct link between semantics and prosody.

To conclude, while pitch accents have been assumed to function as focus markers, our results regarding the statistically significant effect of a prosodic phrase break provide evidence that these accents may also coincide with an obligatory phrase boundary in alternative questions. Furthermore the importance of accentual characteristics and phrasal boundary placement in the disambiguation of declaratives is further evidence that these features are crucial in the disambiguation of disjunctive questions.

6.2 The Importance of the Final Contour

The results of the forced-choice listening task show that final contour is a statistically significant predictor of the interpretation of ambiguous disjunctive questions. Like Bartels (1999) and Pruitt (2007), we found that a falling final contour increased the likelihood of an alternative interpretation and that a rising contour led to a polar interpretation. However when the disjuncts were non-final, accenting had a larger coefficient than final contour did. Furthermore the importance of accenting and prosodic phrasing in declaratives, as we explained above, provides further evidence that those prosodic features are the most important in determining the nature of the disjunction, whether inclusive or exclusive. We conclude the final contour may not directly be related to the determination of the disjunction, but is assigned because of the type of question that the inclusive or exclusive disjunction causes. For example, the inclusive disjunction leads to a polar question, the syntactic structure of this inclusive disjunction is realised prosodically by the lack of phrase boundary between the

disjuncts and the absence of accenting. Furthermore because the question is a polar question, which in English is normally realised with a final rise, the disjunctive question too, will have a final rising contour. Finally in the case of the alternative question, the final contour will be a falling contour, as in other non-polar questions, which are not marked.

6.3 The Critique of Semantic Models

If we take into consideration that both cues are obligatory for the interpretation of disjunctive questions, then we must critically look at the semantic models that have been proposed to illustrate the use of prosodic features in disambiguation. Roelofsen & Pruitt (2013) concluded in their final published article on disjunctive questions that any thorough model would need to include both accents and final contour, as important cues in the disambiguation of disjunctive questions. From our investigation we conclude that this indeed must be a mandatory criterion, if the purpose of the model is to fully illustrate the psychological reality of the disambiguation. Therefore analyses of disjunctive questions, for example Bartels (1999), Han & Romero (2004), Beck & Kim (2006), should be reviewed. Additionally we have stressed that the presence of a prosodic phrase boundary is a crucial factor in the determination of the nature of the question, however this has received little or no attention in any of the studies that we reviewed.

Secondly, one of the biggest problems in semantic literature that uses phonological terms, is that they often do not define the phonetic and phonological terms exhaustively. Terms such as focus and focus-marker, stress versus phrasal-stress can create a lot of confusion if one does not elaborate on the intended definition or refer to a phonetic framework in which they work (see Beaver et al. (2007) for an investigation into the various uses of *focus* in phonology). Furthermore we argue that it is necessary for more research to be done between the semanticist and phonetician in order to further investigate the cues needed in disambiguation of disjunctive questions. For the semanticist, using one cue may lead to a simple yet theoretically appealing model, but for the phonetician, it will not do justice to the intricacy of the prosodic factors that are used, and their interaction with each other.

We would also like to note that although cue-weighting experiments can prove invaluable in phonetic research, they should not be taken to assume that one cue is the only essential factor. Pruitt found that the final contour was the most deciding factor in her experiment, however we cannot conclude that it is the only salient cue. Moreover the mismatching of cues in manipulated stimuli forces participants to make a choice after listening to a sentence that may not sound natural to them. Such experiments can be used in order to rank cues (Bögel, 2013). A further important step in the study of disjunctive

questions would be to rank cues as constraints in a similar manner to that in optimality theory. This elaboration would not only add to the fields of phonetics, but is a crucial step in text to speech improvement Bögel (2013). Furthermore Bögel states that speakers are not consistent in which cues they use as most salient. We would recommend further analysis of the cues used by individual speakers in this study, in order to investigate individual differences between speakers.

In conclusion, while the semanticist may choose to give a simplified but theoretically aesthetic account of the prosody of disjunctive questions, we will argue that it is the combination of prosodic features that typifies both the alternative and the polar disjunctive question.

7. Conclusion

In this study we investigated the cues used in the disambiguation of disjunctive questions. In a forced-choice listening task participants listened to disjunctive questions that differed with respect to their accentual characteristics on the disjuncts and final contour. Secondly we included questions that differed with respect to the insertion of a pause of 270ms versus absence of a pause. Participants had to choose between a polar reading and alternative reading. Our results show that when the disjuncts were sentence final, final contour was statistically the most salient cue; accents on the disjuncts were also statistically significant. When the disjuncts were non-final, we saw the opposite trend whereby accentual characteristics were statistically more salient. We also found that the insertion of a pause had a positive effect on the amount of alternative responses. We conclude that both accents on the disjuncts and final contour are needed in order to disambiguate disjunctive questions. The effect of pause insertion shows that prosodic phrasing is also a very important feature of alternative questions that serves to represent the underlying syntactic structure.

Secondly we have looked critically at the development of semantic models of disjunctive questions, which predominantly use introspection or poor understanding of phonetics. We have criticised the approach of using one cue as most salient, when both cues should be included in any thorough model. Many models have been developed that attribute a semantic focus function to the accents on the disjuncts, but as we have seen from the positive effect of pause insertion, prosodic phrasing seems to be a key element used in the disambiguation and that manifestation of accents and prosodic phrasing are linked. Therefore the accent on the first disjunct, while it may have a focus function, is also a marker of phrase boundary, which signifies the underlying syntactic representation.

Finally we wish to emphasise the interdisciplinary work that needs to take place in order to further investigate the cues used in disambiguation, and the development of an appropriate model that takes all relevant cues into account. Furthermore, a further investigation into the perception of disjunctive declaratives should shed light on the cues needed in their interrogative counterparts.

8. References

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9. Appendix: Stimuli

SYNTAX 2	SYNTAX 1
Did Bill or John clean the car?	Is she allergic to dairy or soy?
Did the bear or the lion cross the road?	Does he speak English or French?
Did Jim or Mary live in France?	Would you like coffee or tea?