

On rises and falls in interrogatives

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Abstract :

This paper first reviews a little-known but, I argue, important assumption made by Bartels 1997: Intonational meanings (here assertive [↗] vs. non-assertive [↘]) do not operate on the literal meaning of a sentence. Instead, they operate on salient propositions. The paper separates this claim from the details of English intonation and shows its success for a range of sentence types in German: statements, yes/no questions, wh-questions, alternative questions and declarative questions.

This paper then reviews results concerning Brazilian Portuguese nuclear contours in statements, yes/no questions and so-called surprise questions. Surprise questions are argued to be functionally comparable to English declarative questions. It is argued that Brazilian Portuguese pitch accents simultaneously encode two dimensions: on the one hand declarative vs. interrogative (encoded in the syntax in English and German); on the other hand, assertive [↗] vs. non-assertive [↘] (also encoded in the intonation in English and German).

1. Intonation as assertive/non-assertive, operating on salient proposition

This section 1 seeks to develop an understanding of core elements of intonational marking of interrogatives. A centerpiece is a suggestion of Bartels (1997) that is rarely cited and somewhat hidden in her 500+-page thesis. It seems to me to move our understanding of how intonational meanings operate in the right direction. Section 2 extends the analysis to declarative questions. Section 3 provides independent support for Bartels' suggestion. Section 4 shows an extension of the components introduced in the first sections to the intonation system of Brazilian Portuguese.

1.1. The issue

I concentrate on the broader notion of what is sometimes called *yes/no question intonation*, across languages. I illustrate with German examples.

The issue is what *yes/no question intonation* means, and how this meaning is contributed in grammatical terms. To begin with, consider the declarative sentence (1a). It is turned into a declarative question (1b) when yes/no question intonation is employed with it. I mark yes/no question intonation in German as the rise [↗] and its counterpart as the fall [↘].

(1) *Syntactic declaratives: intonation makes a difference to the interpretation*

- a. Peter hat eine Katze [↘] (statement)
- b. Peter hat eine Katze [↗] (declarative question)
'Peter has a cat.'

Does yes/no question intonation then mark the speech act question? This hypothesis is easily falsified because other question speech acts do not require this intonational pattern, and some in fact reject it. The well-known core cases are shown for German in (2). Though yes/no

questions as in (2a) typically do show yes/no question intonation (the name is no accident), wh-questions as in (2b) more typically show the absence of it, and alternative questions as in (2c) require the absence of yes/no question intonation in final position. All these are question speech acts that seek an answer from the addressee.

(2) *Syntactic interrogatives: speech act question throughout but different intonation*

- a. Hat Peter eine Katze [/] (yes/no question typically rising)
'Does Peter have a cat?'
- b. Was für eine Katze hat Peter [\] (wh-question often falling)
'What kind of cat does Peter have?'
- c. Hat Peter einen Hund oder eine Katze [\] (alternative question always falling)
'Does Peter have a dog or a cat?'

From the perspective of German, an improved hypothesis that goes a step further was suggested by Kretschmer (1938).¹ Kretschmer suggested that rising intonation marks continuation in all cases, and that (German rising) yes/no question intonation simply marks continuation before an elided part of the question. (3a) shows a standard case of [/] as marking continuation at the end of a clause continued by a second clausal conjunct. At the end of the utterance, we find the final fall [\]. An alternative question, as in (3b), shows the same distribution of [/] and [\], the medial [/] marking continuation within the utterance, and the final [\] the absence of this. Thus, the intonation pattern of alternative questions is as expected. The crucial case of yes/no question intonation is derived as shown in (3c): Here, too, a second conjunct is assumed, the negation of the first conjunct. This is quite coherent from the perspective of recent interrogative semantics: A standard semantic analysis of yes/no questions is that they are hidden alternative questions; see e.g. Karttunen (1977).² Kretschmer's suggestion is then that the second conjunct is elided in yes/no question, but that the rising continuation at the end of the first conjunct, which originally announced the continuation in the second conjunct, is retained. Yes/no question intonation here marks continuation, as in other cases, in Kretschmer's suggestion. Finally, wh-questions as in (3d) do not have such a hidden continuation, and therefore no final rise is expected.

- (3)a. Maria hat einen Hund [/] und Peter hat eine Katze [\].
'Mary has a dog and Peter has a cat.'
- b. Hat Peter einen Hund [/] oder hat er eine Katze [\]. (alternative question √)
'Does Peter have a dog or does he have a cat?'
- c. Hat Peter eine Katze [/] ~~oder hat er keine Katze [\].~~ (yes/no question as elliptical;
'Does Peter have a cat or doesn't he have a cat?' [/] marks silent continuation. √)
- d. Was für eine Katze hat Peter [\]. (wh-question: no silent continuation √)
'What kind of cat does Peter have?'

¹ Kretschmer, originally from Berlin, was a professor in Vienna, and retired around the time his article appeared. 1938 was also the year of the 'Anschluss' of Austria to Nazi Germany. I could not find information about involvement of him with the Nazis before or after that. There are also no political asides in this linguistic article. Kretschmer is the only one I am aware of to have articulated this proposal. H.T.

² The perspective is not uncontroversial, see Bolinger (1978), Bartels (1997), Romero & Han (2004).

However, Kretschmer's hypothesis does not work across languages. There are many ways of marking yes/no questions across languages, which are not also used for continuation (see Haan 2001 and references there). In English, for example, the yes/no question contour is $L^* H- H\%$ while continuation in assertions is marked with $H^* L- H\%$ (see Pierrehumbert & Hirschberg 1990 and Bartels 1997).

Bolinger (1957), (1989), Gussenhoven (1984):Ch.6, Pierrehumbert & Hirschberg (1990), and Bartels (1997) see parts of tunes of the English intonation system as abstract morphemes with pragmatic meaning.

Bolinger distinguishes three core accents, of which the A accent is assertive. Bolinger calls the C accent *anti-assertive*. What I here refer to as yes/no question intonation belongs to this category C. The perspective that yes/no question intonation is the absence or negation of an assertive meaning of some sort is also taken in the other works cited in the preceding paragraph. This perspective is also pursued by Bartels and in this paper. On its own, however, it does not solve our simple puzzle: All three examples in (2) are interrogatives. If (2a) is marked as non-asserted, why are (2b) and (2c) not similarly marked as non-asserted? What is it that is asserted in (2b) and in (2c)?

1.2. Intonational meanings operate on salient propositions

In this section, the relevant suggestion of Bartels (1997) is introduced and illustrated with core cases.

While Bartels develops her suggestions with regard to the elements of English intonation, I keep employing the broader notions $[\backslash]$ and $[/]$. For German, I identify $[\backslash]$ with an L% boundary tone and $[/]$ with an H% boundary tone (see Féry 1993, Grice, Baumann, & Benzmueller 2005, Uhmman 1991). I take $[\backslash]$ to be assertive and $[/]$ to be non-assertive. I assume for concreteness that the non-assertive meaning of $[/]$ is inherent to $[/]$, though it is also conceivable that $[/]$ is instead meaningless and its non-assertive interpretation triggered by an implicature due to the non-employment of the assertive $[\backslash]$.

- (4) a. $[\backslash]$ p: speaker asserts p
b. $[/]$ p: speaker does not assert p

In the contrast between (1a) and (1b), the speaker S thus marks S's asserting intent in (1a) by the use of $[\backslash]$. In (1b), S marks that S does not assert p. This alone does not suffice to explain the questioning impact of (1b), to which I return. It suffices to mark the speech-act as something other than an assertion of the content.

Bartels' important suggestion concerns the nature of p, the proposition modified by the intonational meanings $[\backslash]$ and $[/]$ in (4). Bartel's suggestion is that this p is crucially not the literal (compositional) meaning of the clause modified (or a part of this literal meaning), but instead a salient proposition. Salient, we may say in a good first approximation, in connection with the wording and literal (compositional) meaning of the original utterance.

- (5) Suggestion of Bartels (1997): Intonational meaning operates on salient propositions.

In the case of (1), the declarative sentence has a proposition as its meaning (i.e. *Peter has a cat*), and the most salient proposition in connection with this literal meaning is that same proposition, *Peter has a cat*. This particularly salient proposition is also the proposition modified by the intonational meanings $[\backslash]$ in (1a) and $[/]$ in (1b).

The fruitfulness of Bartel's suggestions in terms of salient proposition emerges in interrogative clauses. Here the literal meaning of the interrogative clause is not a proposition,

but a more complex semantic object.³ Different salient propositions then come into view with different kinds of interrogatives. In the alternative question *Does Peter have a dog or a cat?* in (6) a particularly salient proposition is *Peter has a dog or a cat*. This proposition is particularly close to the original wording, undoing only the syntactic inversion (or, semantically, removing the effect of the interrogative Q-marker and its association with the disjunction). It makes sense in alternative questions that this proposition is endorsed, or asserted, by the speaker, for this is independently an aspect of the interpretation of alternative questions. The final fall in alternative questions thus has a sensible interpretation: The speaker asserts with [∨] that one of the alternatives is true.

(6) *Alternative question*

Hat Peter einen Hund [∨] oder eine Katze [∨]L%
'Does Peter have a dog or a cat?'

Most salient proposition: *Peter has a dog or a cat*.

⇒ [∨]L% marks: speaker asserts that Peter has a dog or a cat.

Consider then yes/no questions as in (7). For the yes/no question *Does Peter have a dog?* a particularly salient proposition is *Peter has a dog*. This is similarly close to the original wording, undoing only syntactic inversion (or semantically, removing the interpretative effect of the Q-marker). In this case, however, this salient proposition ought not to be endorsed by the speaker, for otherwise the questioning intent would be undermined: The question here seeks to learn from the addressee whether this proposition is true or false. This proposition ought therefore to be marked as non-asserted, i.e. marked with [∧].

(7) *Yes/no question*

Hat Peter einen Hund? [∧]H%
'Does Peter have a dog?'

Most salient proposition: *Peter has a dog*.

⇒ [∧]H% marks: speaker does not assert that Peter has a dog.

This explains the typical use of yes/no question intonation in yes/no questions: It is the presence of this (uninverted) particularly salient proposition that typically prevents the use of asserting [∨] intonation.

In wh-questions, as in (8), no salient proposition can be gotten by simply undoing the syntactic inversion (and perhaps wh-movement), since the wh-word would still mark a semantic 'gap' in the result, i.e. *Peter has what kind of cat* does not have a propositional meaning. Here a further source of salient propositions in interrogatives comes into play. I discuss this source for wh-questions first, and afterwards for alternative questions and yes/no questions. This source is the assumption (often analyzed as a presupposition), in interrogatives, that there is a true answer to the question. For a wh-question like (8), this is obtained by not only undoing inversion and wh-movement, but also replacing the wh-word

³ Depending on the theory, this is the set of possible answers (Hamblin 1973), or the set of true answers (Karttunen 1977) which is normally not known to the speaker, or the maximal true answer (Groenendijk & Stokhof 1982), which is likewise normally not known to the speaker.

with an indefinite expression: *Peter has some kind of cat.*⁴ Since this salient proposition is a speaker assumption, or presupposition, independently conveyed by the wh-question, the speaker will normally endorse it by [∨] intonation (rather than marking the absence of its endorsement by [∕]).

(8) *Wh-question*

Was für eine Katze hat Peter? [∨]L%
'What kind of cat does Peter have?'

Salient proposition: *Peter has some kind of cat.*

⇒ [∨]L% marks: speaker asserts that Peter has some kind of cat.

Returning then to alternative questions and yes/no questions, what about the salient proposition that there is a true answer with those question types? With alternative questions such as *Does Peter have a dog or a cat?*, the assumption of a true answer is in fact identical to the salient proposition already postulated above, e.g. *Peter has a dog or a cat.* Here, then, no additional intonational possibilities are predicted. This is a desirable result, since the final fall in alternative questions is close to obligatory.

Matters are different with yes/no questions. The existence of an answer (yes or no) to *Does Peter have a dog?* is this: *Peter has a dog or he doesn't.* Bartels argues that we indeed find speaker-assertion of such a salient proposition (with [∨], in my terms). Where this occurs, a pragmatic effect is observed that is expected on the analysis laid out here: By asserting that an answer exists one way or the other, the speaker tries to keep the addressee to the point.⁵

(9) *Yes/no question with a fall*

Hat Peter einen Hund? [∨]L%
'Does Peter have a dog?'

Salient proposition: *Peter has a dog or he doesn't.*

⇒ [∨]L% marks: speaker asserts that Peter has a dog or he doesn't.
(pragmatic impact: which is it, this or that?)

2. Declarative questions

In this section I extend the analysis to declarative questions like (1b). The extension also leads to assumptions about a speech-act contribution of the declarative sentence form, which will again be relevant in the analysis of Brazilian Portuguese in section 4.

Declarative questions are syntactically declarative sentences (without inversion or wh-word) that are employed as questions. The questioning intent is typically recognized by rising intonation [∨]. Gunlogson 2001 shows that a declarative question [p?] (or, here: p[∨]) requires

⁴ Semantically (depending on the details of the semantic account of interrogatives), this may still be seen as the removal of the effect of the Q-marker and its associated interrogative effects, if the difference between a wh-word and an indefinite is the association with the Q-marker of the former.

⁵ Bartels' account is actually more complex. She partly adopts a suggestion of Bolinger (1978) that yes/no questions are not hidden alternative questions but semantically singletons, interested only in the truth of the underlying proposition, such as {Peter has a dog} in (9). Bartels modifies this and allows both singleton and hidden alternative question readings of yes/no questions. The latter would be {John has a dog, John doesn't have a dog} for (9). The salient proposition of a singleton reading, the single proposition, is marked by the rise in a genuine yes/no question. The salient proposition of a hidden alternative question is the disjunction of the alternatives, and is marked by a fall.

that the addressee can be assumed to believe *p*, i.e. it requires that it can be assumed that the answer is 'yes'. (10) reviews that yes/no questions can be used to ask genuinely open questions, where the answer may be 'yes' or 'no'. (11) shows that declarative questions cannot be used for asking about such genuinely open issues. (12) shows examples of felicitous declarative questions with their contexts. In these cases, it can be assumed that the addressee *A* of the declarative question by *B* believes *p*, the proposition of the declarative question. In the echoing context (12a), the proposition of the declarative question by *B* is that *there is a leopard in the living room*. The addressee *A* of the declarative question can be assumed to believe this proposition, since *A* has just asserted this. In (12b), addressee *A* of the declarative question can be assumed to believe *p*, that France is a monarchy, since *A* has presupposed as much by the use of *the king of France*. The discourse in (12c) is felicitous on the assumption that *A*'s having talked to Helena can be inferred from *A*'s knowing that Mark and Helena are leaving for Japan in the current week. Here, too, the condition is satisfied. It can be assumed, from what *A* said, that *A* believes that *A* talked to Helena.

(10) *Open issues: Yes/no question OK*

- a. It's an open question: Did she lie to the grand jury?
- b. I can't decide: Should I wash my hair tonight?
- c. [guessing game] Is it bigger than a bread-box?

(11) *Open issues: Declarative question not OK*

- a. # It's an open question: She lied to the grand jury?
- b. # I can't decide: I should wash my hair tonight?
- c. # [guessing game] It is bigger than a bread-box?

(12) *Addressee can be assumed to believe p: Declarative questions OK*

- a. *A*: There is a leopard in the living-room.
B: There is a leopard in the living-room?
- b. *A*: The king of France is bald.
B: France is a monarchy?
- c. *A*: Mark and Helena are leaving for Japan this week.
B: Oh ... you talked to Helena?

Gunlogson develops an interesting, though formally somewhat complex, account, of which I here adopt elements of the architecture and one core ingredient, to tentatively assemble a revised more informal account. The architecture of Gunlogson's account is that the declarative syntax restricts the speech act interpretations of the declarative sentence, and the intonation also restricts the speech act interpretation, and that the restrictions on the use of declarative questions follow from the interaction of these two factors. Her suggestion is furthermore that the declarative syntax requires that either speaker *S* or addressee *A* believe the declarative proposition *p*. I adopt this here with a change from believing to saying. I further postulate that a semantic (not syntactically represented) interrogative *Q* component can be optionally added, with scope over the speech act component of the declarative. Thus, the declarative question in (13a) has the interpretation sketched in (13b). The interpretation is paraphrased in (13c). For comparison, (14b) shows the interpretation of a standard declarative in (14a), with the speech act component '*S* says'. In both cases, the component *S/A* says is taken to be triggered by the

declarative sentence form. It is crucial that, as in Gunlogson's suggestion, the person doing the believing (or, here, saying) is flexible between S and A.

- (13) a. France is a monarchy?
 b. Q [A says [that France is a monarchy]]
 c. Are you saying that France is a monarchy?
- (14) a. France is a monarchy.
 b. S says [that France is a monarchy]

In this suggestion, a declarative question [p?] is more generally interpreted along the lines of *Are you saying that p?* This accounts for their non-occurrence in the open contexts in (11), and for their occurrence in the contexts in (12) where A has asserted, presupposed, or licensed an inference that p.

In this account, the role of the intonation in the relevant core cases is then as follows: [∖] disambiguates in favor of (14b), and [/] disambiguates in favor of (13b). This is shown in (15) and (16) with similar German examples. First, the example in (15) shows that the declarative interpretation in (14) is compatible with [∖]. On the most plausible interpretation of the fall in (15c), the declarative interpretation (15c) is in fact doubled by the intonational interpretation in (15c). (15d) is added for completeness, and (15e) shows that a rising interpretation is not semantically compatible with the statement interpretation at hand.

- (15) a. Frankreich ist eine Monarchie. [∖]L%
'France is a monarchy.'
 b. S says [that France is a monarchy]
 c. Salient proposition 1: [that France is a monarchy]
 ⇒ [∖]L% marks: S asserts that France is a monarchy
 d. Salient proposition 2: S says [that France is a monarchy]
 ⇒ [∖]L% mark: S does not assert that France is a monarchy
 e. Incompatible marking with [/]H%:
 # S does not assert that France is a monarchy
 # S does not assert that S says that France is a monarchy

Therefore, the deployment of [/]H% blocks the statement interpretation. (16) shows that [/]H% is compatible with the declarative question interpretation of (13). The two relevant salient propositions in (16c) and (16d) may reasonably be marked by rising intonation: The speaker does not (perhaps not yet) endorse A's having just said that France is a monarchy, and the speaker does not (perhaps not yet) endorse that France is a monarchy.

- (16) a. Frankreich ist eine Monarchie? [/]H%
'France is a monarchy?'
 b. Q [A says [that France is a monarchy]]
 c. Salient proposition 1: [A says [that France is a monarchy]]
 ⇒ [/]H% mark: S does not assert that A says that France is a monarchy
 d. Salient proposition 2: [France is a monarchy]
 ⇒ [/]H% mark: S does not assert that France is a monarchy

The particulars of the account are in part motivated by an extension to echo questions which I defend in more detail in other ongoing work. For the purpose of this paper, the account captures Gunlogson's observation in connection with (11) and (12). Further, it provides an independent question interpretation for declarative questions, in favor of which intonational marking can disambiguate. Finally, the account allows me to spell out how the intonation can disambiguate between a statement and a declarative question interpretation.

3. Further evidence that intonational meanings operate on salient propositions

In this section, two cases from Pierrehumbert & Hirschberg (1990) are reviewed that may be seen as support for the suggestion that intonational marking can operate on salient propositions, rather than being confined to operating on literal meaning.

First, in the example in (17), from Pierrehumbert & Hirschberg (1990):290, Mark Liberman approaches a receptionist to find out whether he is in the right place for his appointment. The high-rise intonation contour here allows for a combination of assertive and non-assertive meaning. First, the H*, part of the standard English assertive contour H* L-, seems to contribute assertion in the sense that the speaker asserts that his name is Mark Liberman. If H* were here changed to non-assertive L*, the sentence would convey that the speaker has forgotten his name, which is not what (17) conveys. At the same time, the final H-/H% edge tones convey something questioning, along the lines of 'Am I in the right place for my appointment?'. This latter aspect, it seems to me, cannot be captured if intonational meaning would operate on literal sentence meaning, i.e. it could not be captured by the speaker denying that his name is Mark Liberman, or denying that he is saying that his name is Mark Liberman. Rather, it would seem to be the marking of a salient proposition, along the lines of: 'The speaker is not asserting that he is in the right place for his appointment.'

- (17) H* H* H- H%
 My name is Mark Liberman

Second, Pierrehumbert & Hirschberg (1990):293f observe that marking of vocatives with H* vs. L* correlates with whether the speaker has the attention of the addressee or not.

- (18) H* if S does not have the attention of Anna
 L* if S already has the attention of Anna
 Anna, your lunch is ready.

This fits into their account where H* marks new and asserted information while L* marks given or non-asserted information, so long as these tones mark the proposition 'I am talking to you'. This proposition would be marked as asserted and new by H* and as given by L*. This proposition is of course part of the way the vocative is understood. However, it is at least not clear that it is part of a compositional process of interpretation of the vocatives. If it is not, then it is another salient proposition outside of the compositional interpretation, which may be marked by intonational meaning.

4. Intonation in Brazilian Portuguese

In this section, I review core results on the intonation of Brazilian Portuguese from Truckenbrodt, Sandalo, & Abaurre (2009). They are interesting for the current paper, since there is no syntactic inversion to distinguish a yes/no question from a declarative in Brazilian Portuguese. Instead, this distinction is carried by the intonation as well. There is, in addition, a question type comparable to declarative questions. It is argued that two dimensions of intonational marking can be isolated: On the one hand, the distinction between declaratives and interrogatives (what is marked by inversion in English); on the other hand, the distinction marked by [ˀ] vs. [ʔ] in the discussion above, i.e. assertive vs. non-assertive intonation.

4.1. Literature on Brazilian Portuguese nuclear contours

Perception experiments of de Moraes (1984), (1998) show that a relatively low stressed syllable is perceived as declarative and a relatively high stressed syllable as interrogative. It seems to be the tonal height, rather than the tonal movement (falling vs. rising) that are crucial for this.

The starting point of the investigation was a classification of main intonational contours of Brazilian Portuguese by Cagliari (1982). It is drawn and reproduced in (19), with translations added on the right.

(19) Classification of main intonation contours by Cagliari 1982:

Tom	Padrão	Significado	Exemplo
1	--- --ˀ	declaração, asserção	 Ontem choveu muito.
2	--- --ʔ	interrogação	 Está chovendo?
3	--ˀ ---	incompleto	 Ela disse: (fique quieto)
4	--- --ʔ	surpresa interrogativa	 Eu não sei?!
5	--ˀ --ˀ	asserção enfática	 Mas eu entreguei o trabalho!?
6	---ˀ ---	“certas” frases relativas	 Foi ela quem me disse.

statement:
'Yesterday it rained a lot.'

question:
'Is it raining?'

incomplete expression:
'She said:' ('be quiet')

surprise question:
'I don't know?!'

emphatic assertion:
'But I handed over the paper!?!'

cleft sentence:
'It was her who told me.'

The statement category 1 is described in de Moraes 1998:183 as follows: "the neutral declarative pattern in BP is characterized by a drop in fundamental frequency (F0) at the end of the utterance (more precisely, on the final tonic) (...)." This is further compatible with the transcription H L* L_i of Tenani 2002.

The yes/no question category 2 is also described in Gebara (1976) as having a final rise; de Moraes 1998 writes that given penultimate stress, the yes/no question rises to a peak on the stressed syllable but falls again on the final syllable.

Category 3 is marking of continuation.

Category 4 is the surprise question, a category from the Brazilian Portuguese literature, which is argued below to be functionally similar to the declarative question of English. Its intonation is drawn by a different contour from that of yes/no questions by Cagliari. Gebara 1976, on the other hand, sees the difference in a higher pitch range for surprise questions.

Category 5 is that of emphatic assertions. Category 6, focus intonation in a cleft sentence, is not relevant here. Further details about the previous literature can be found in Truckenbrodt, Sandalo, & Abaurre (2009).

4.2. Surprise questions and declarative questions

Brazilian Portuguese surprise questions seem to be similarly restricted in use to English (and German) declarative questions. Brazilian Portuguese equivalents of (10) - (12) are shown in (20) and (21). The open questions in (20) are possible with yes/no question intonation, but not with surprise question intonation, just as their English equivalents are possible as yes/no questions in (10) but not as declarative questions in (11). Surprise questions are possible in (21), the contexts that also license declarative questions in English in (12).

(20) Yes/no questions but not surprise questions

- a. É uma questão aberta: Ela mentiu ao júri?
'It's an open question: Did she lie to the jury?'
- b. Não consigo decidir: Lavo o cabelo esta noite?
'I can't decide: Should I wash my hair tonight?'
- c. [guessing game]
É maior que um laptop?
'Is it bigger than a laptop?'

(21) Surprise-questions possible

- a. A: Tem um leopardo na sala de estar.
'There is a leopard in the living-room.'
B: Tem um leopardo na sala de estar?
'There is a leopard in the living-room?'
- b. A: O rei da França é careca.
'The king of France is bald.'
B: A França é uma monarquia?
'France is a monarchy?'
- c. A: Marcos e Helena estão indo ao Japão nesta semana.
'Mark and Helena are leaving for Japan this week.'
B: Ah, então você falou com Helena?!
'Oh, so you talked to Helena?'

Thus, surprise questions in Brazilian Portuguese are functionally similar (perhaps equivalent) to declarative questions in English (and German).

4.3. Experimental results

Five intonational categories from Cagliari 1982 were investigated: statements, emphatic statements, yes/no questions, surprise questions, continuation. Three sentences with antepenultimate stress in the final word were employed. This final word is taken to carry the nuclear stress of the sentence. For each of these sentences, five contexts according to the five categories were constructed. (22) - (26) shows the English translations of these contexts for one of the three sentences.

- (22) Statement
'What would happen if Chomsky wrote another book?' [experimenter]
 Nós alunos leríamos. [subject]
'We students would read it.'
- (23) Statement with continuation
'What do you think would happen if Chomsky wrote another book?' [e.]
 Nós alunos leríamos, mas talvez tivéssemos muita dificuldade. [s.]
'We students would read it, but maybe we would have much difficulty.'
- (24) Emphatic statement
'I don't think you would read it if Chomsky wrote another book.' [e.]
 Mas nós alunos leríamos! [s.]
'But we students would read it!'
- (25) Yes/no question
'What do you think would happen if Chomsky wrote another book?' [s.]
 Nós alunos leríamos?
'Would we students read it?' [s.]
- (26) Surprise question
'I think you students would read it if Chomsky wrote another book.' [e.]
 Nós alunos leríamos!? De jeito nenhum. [s.]
'We students would read it!? No way.'

The study focused on speakers from the Campinas area in Brazil. Six speakers read each of the three sentences in each of the five contexts. There were no repetitions. 90 tokens were thus recorded in the production part.

In a subsequent perception task, 24 listeners judged for each token, which of the five contexts it fits best. This led to 24 times 90 = 2160 judgments. The statistical evaluation of the judgments showed that all five categories were perceptually distinguished significantly well. The statistical evaluations of individual productions further led to an identification of those productions that were recognized as members of their category particularly well. These productions (ignoring here the category of continuation) are plotted in Figure 1.

The first two plots show that normal statements and emphatic statements primarily differ in tonal height, with emphatic statements showing greater height. This conforms to a suggestion of Bolinger (1986) that tonal height can increase with the degree of speaker involvement. The two statement contours show similar temporal alignment (leaving aside an optional dip preceding the peak in emphatic statements). Both contours are analyzed as H+L* L%.

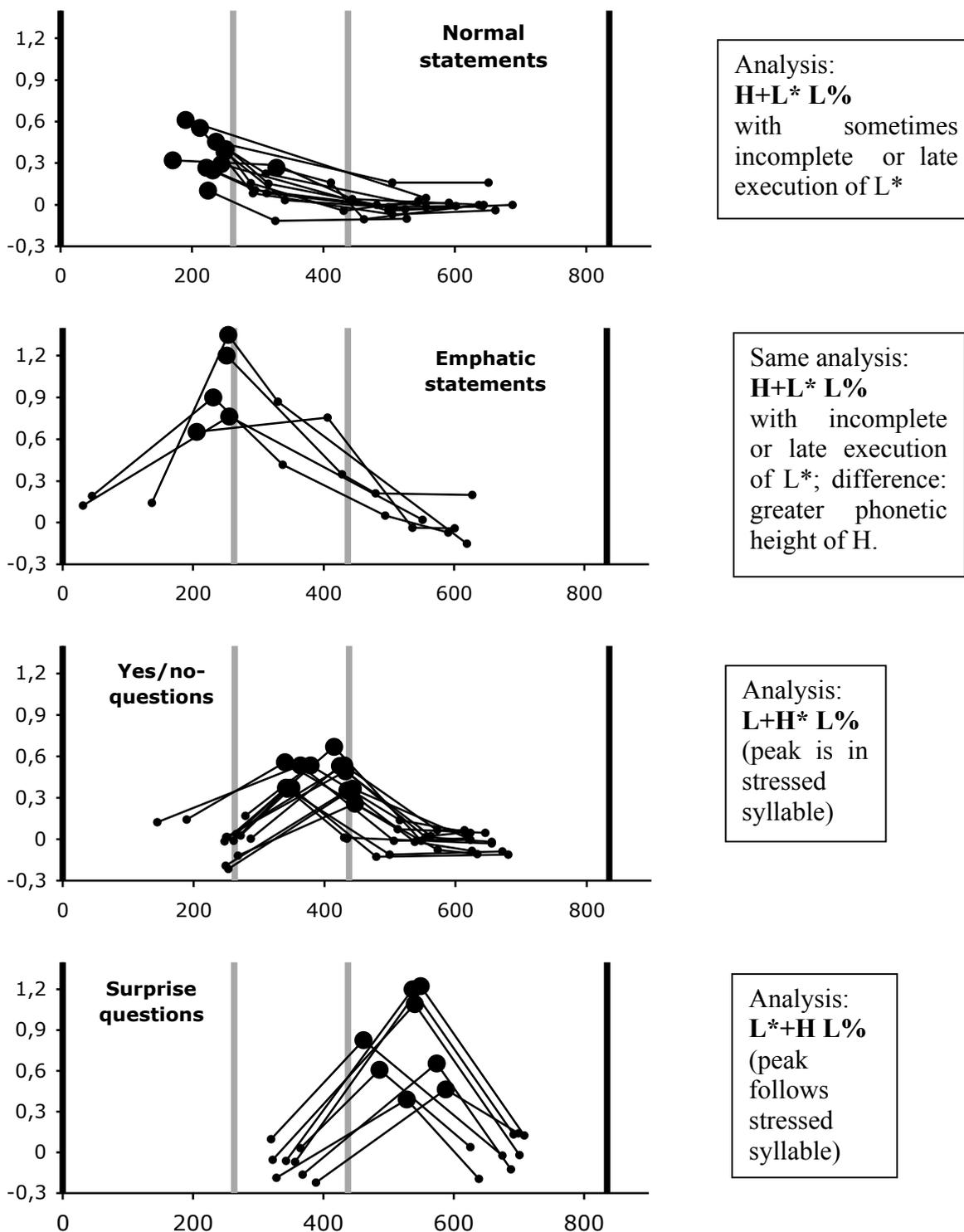


Figure 1. Plots of the tokens that were recognized particularly well in the perception experiment for normal and emphatic statements, yes/no and surprise questions. The vertical black bars represent the extent of the final verb. The vertical grey bars delimit the stressed syllable in the verb. The plots are normalized across speakers for F0, and for time (preserving relative position within the three temporal segments of the plots) and pool the particularly well recognized productions of all six speakers.

Yes/no questions and surprise questions, in the third and fourth plot of Figure 1, also exhibit a difference in height. The greater height in surprise questions can similarly be related to greater speaker involvement there. Importantly, these two question types also show a consistent difference in temporal alignment, which cannot be analyzed as a secondary effect of the difference in height. Both show a fall-rise. The rise of the yes/no question begins around the beginning of the stressed syllable and the peak falls in or around the second half of the stressed syllable. By contrast, the rise in surprise questions begins later, around the middle of the stressed syllable, and ends later, after the stressed syllable. Accordingly, the contour of yes/no questions are analyzed as L+H* and the contour of surprise questions as L*+H. They are both followed by a L% boundary tone in the tonal analysis.

The tonal contours can be decomposed into the components declarative/interrogative and assertive/non-assertive, the latter equivalent to what is discussed as [∇] and [/] above. All these distinctions reside in the nuclear pitch accents in Brazilian Portuguese (where they are followed by an L% boundary tone in the patterns of Figure 1). The analysis is formally similar to the decomposition of English bitonal pitch accents in Pierrehumbert & Hirschberg (1990) (though the meanings differ). As shown in (27), declarative pitch accents contain L*, interrogative ones contain H*, in accord with de Moraes' perceptual results. Further, a falling H+L pitch accent is interpreted as assertive, a rising L+H pitch accent as non-assertive. From this, one obtain the combinations in (28), in accord with the experimental results.

- (27) a. declarative: L*; interrogative: H*
 b. assertive "[∇]": H+L; non-assertive "[/]": L+H

- (28) statement = declarative (L*) with assertion (H+L) = H+L* L%
 yes/no question = interrogative (H*) with non-assertion (L+H) = L+H* L%
 surprise question = declarative (L*) with non-assertion (L+H) = L*+H L%

5. Summary

Yes/no question intonation ([/]) can be analyzed as non-assertive intonation in contrast to assertive statement intonation ([∇]). Its distribution in interrogatives is plausibly captured, following Bartels (1997), in an analysis in which these intonational morphemes do not mark part of the literal, compositional, meaning, but modify instead salient propositions. Yes/no questions are special insofar they have a salient proposition that must not be marked as asserted by the intonation (for *Is it raining?*, this proposition is *It is raining.*).

Declarative questions, following Gunlogson (2001), involve a speech-act component brought about by the declarative sentence form, by which speaker or addressee believe/say the proposition of the declarative. I suggest that they independently invoke a (grammatically optional) semantic (though not syntactic) interrogative component.

In the intonation of Brazilian Portuguese, all these dimensions are encoded in the nuclear pitch accents. The analysis reviewed assigns declaratives to L*, interrogatives to H*, assertive intonation to H+L, and non-assertive intonation to L+H.

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