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**Title:** When pitch accents encode speaker commitment: evidence from French intonation

**Short running title:** Intonational encoding of speaker commitment in French

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**Abstract:** Recent studies on a variety of languages have shown that a speaker's commitment to the propositional content of his or her utterance can be encoded, among other strategies, by pitch accent types. Since prior research mainly relied on lexical-stress languages, our understanding of how speakers of a non-lexical-stress language encode speaker commitment is limited. This paper explores the contribution of the last pitch accent of an Intonation Phrase to convey speaker commitment in French, a language that has stress at the phrasal level as well as a restricted set of pitch accents. In a production experiment, participants had to produce sentences in two pragmatic contexts: unbiased questions (the speaker had no particular belief with respect to the expected answer) and negatively-biased questions (the speaker believed the proposition to be false). Results revealed that negatively-biased questions consistently exhibited an additional unaccented f<sub>0</sub> peak in the preaccentual syllable (an H+!H\* pitch accent) while unbiased questions were often realised with a rising pattern across the accented syllable (an H\* pitch accent). These results provide evidence that pitch accent types can signal the speaker's belief about the certainty of the proposition expressed in French. It also has implications for the phonological model of French intonation.

**Keywords:** intonation, pitch accent, speaker commitment, French.

## **INTRODUCTION**

### **Intonational encoding of speaker commitment across languages**

As speakers encode speech, they use prosody, together with other linguistic strategies (e.g., lexical and/or morphosyntactic marking) to signal their belief about the proposition they express. This is quite uncontroversial. However, several questions about the relationship between prosody and the encoding of speaker commitment remain open. For instance we may wonder which prosodic features speakers employ to convey their commitment to the content of their proposition and how languages differ in the choice of prosodic (and other linguistic) features they use to express speaker commitment.

Recent studies in the field of intonational phonology have shown that languages rely on different prosodic strategies to distinguish between questions for which the speaker has no particular belief about their propositional content and questions for which the speaker believes the proposition to be true or false (for Italian: Grice & Savino, 1997; Savino & Grice, 2007, 2011; for Majorcan Catalan: Vanrell, Mascaro, Torres-Tamarit & Prieto, 2012; for Puerto Rican Spanish: Armstrong, 2010). In Bari Italian, a language with stress at the lexical level, the choice of a specific pitch accent reflects the degrees of speaker's confidence as to whether or not information is new (Grice & Savino, 1997; Savino & Grice, 2007, 2011). In this variety of Italian, questions about new information are marked by means of an L+H\* accent while both H+L\* and L+H\* [high peak] pitch accents signal questions about given information. In addition, with different degrees of givenness of information, the type of pitch accents can indicate the degree of confidence with which the speaker believes the information to be shared with the interlocutor (Savino & Grice, 1997). When the speaker was asking for new information or when he or she was asking for confirmation of shared information, Grice and

Savino (1997) observed two distinct categories of pitch accents, namely a rising L+H\* pitch accent for a neutral position of the speaker toward the content of the proposition and a high falling H\*+L pitch accent for a positive bias. In another study, Savino & Grice (2011) distinguished a high falling H\*+L pitch accent for what they named "confident check" (i.e., slight positive bias) from a low falling H+L\* pitch accent for "very strong positive bias". The authors also found that Bari Italian speakers use a L+H\* accent in which the peak is higher than the peak of the same pitch accent observed in unbiased contexts to signal that the speaker believes the content of the proposition to be false (Savino & Grice, 2007). Vanrell et al. (2013) also showed that a difference in pitch scaling could signal speaker commitment in Majorcan Catalan. Specifically, they found that the scaling of the leading H tone of the H+L\* pitch accent indicates the contrast between information-seeking questions and confirmation-seeking questions. Indeed, a downstepped !H+L\* pitch accent (i.e., a downstepped H leading tone often realised on the preaccentual syllable and an L\* tone associated with the last stressed syllable of the word, see the most recent version of Cat\_ToBI for the transcription: Aguilar et al. 2009, 2010) signals that the speaker has no expectation about the nature of the answer while an H+L\* pitch accent (i.e., a higher leading tone associated to the preaccentual syllable) indicates that the speaker is asking about mutually shared information. Armstrong (2010) also showed that the location of a rising peak cues speaker involvement in Puerto Rican Spanish. In questions for which the speaker had no particular bias with respect to the expected answer, Armstrong found a downstepped peak associated with the nuclear syllable (!H\* nuclear pitch accent). By contrast, the peak was located in the syllable preceding the nuclear syllable in questions where the speaker believed the proposition content to be true (H+L\*, the fall from a high tone begins in the preaccentual syllable of the utterance-final prosodic word). Thus, Puerto Rican Spanish speakers use two different pitch accents

depending on speaker belief states about the propositional content of the question (!H\* vs. H+L\*).

In contrast with many Romance languages, French has not stress at the lexical level. Rather, stress affects the last full syllable of a prosodic unit smaller than the Intonation Phrase (i.e., the Accentual-Phrase). In this study, we ask whether French speakers prosodically encode speaker commitment and whether they use pitch accent types located at the end of the Intonation Phrase to encode speaker commitment. In French, the contrast between questions for which the speaker has no particular bias with respect to the answer he or she expects (“unbiased questions”) and questions for which the speaker has certain expectations (“biased questions”) can be conveyed by prosody (Fonagy & Bréard, 1973). Note that the distinction between the two types of questions has been described with a wide range of labels. When the information is new (i.e., unknown to the speaker at the time of the asking of the question) so that the speaker has no particular bias with respect to his/her interlocutor’s answer, questions have been mainly referred to in the literature as “queries” (e.g., Carletta et al. 1997; Grice & Savino, 1997; Savino & Grice, 2011) or information-seeking questions (e.g., Armstrong, 2010; Vanrell et al., 2013). On the other hand, when the speaker refers to previously-mentioned information and when he/she is biased towards the expected answer, questions have been mainly referred to as “checks” or “confirmation seeking-questions for positive bias” (i.e., the speaker is asking for the confirmation of shared information) or “objects for negative bias” (i.e., the speaker is challenging what has been said; Savino & Grice, 2011; Vanrell et al., 2013). Here, we use the terms *unbiased questions* for “queries” and “information-seeking questions” and *biased questions* for questions such as “checks”, “confirmation seeking questions”.

Prior research on French intonation have suggested that, in questions, a contour in which fundamental frequency (f0) falls from a peak in the penultimate syllable, which is not

accented, conveys greater uncertainty than intonation contours that have both a final rise or a final fall (i.e., Fonagy & Bréard, 1973). Moreover, in affirmations, the penultimate peak contour has also been described as signalling that the speaker considers the propositional content as obvious (Leach, 1998; Mertens, 1992; Post, 2000). For instance, in a Map task experiment, Post (2000) found a few cases in which pitch contours in Intonation Phrase-final position included a penultimate pitch peak often realised on the preaccentual syllable. The rarity of the penultimate pitch peak in the corpus analysed by Post lead her to conclude that this fundamental frequency (f<sub>0</sub>) pattern cannot be assumed to be the predominant pattern for neutral assertion. In addition, speakers could use the penultimate peak contour to signal that the information in their message is obvious to them but this may not be the case for the listeners (Post, 2000: 137). It is important to note, however, that in certain contexts (e.g., in cases where the penultimate syllable was clearly not accented and the peak was preceded by high pitch level, also described as a "high plateau" by Jun & Fougeron, 2000), the potential instances could be confused with falling f<sub>0</sub> patterns. Since in these cases, the peak was preceded by a high plateau, the instances could be interpreted either as a fall with a high level onset or as a f<sub>0</sub> pattern with a penultimate unaccented peak and no dip before it (Post, 2000: 135; see also Grabe et al., 1998). Beyssade & Marandin (2007) also proposed that, in both affirmations and questions, rising contours could convey a stronger commitment on the part of the speaker than contours that fall from a penultimate peak. Specifically, in a context of possible disagreement between the interlocutors, rising contours appear to signal that the speaker is not ready to revise his/her beliefs concerning the content of the utterance while conversely, falls from a penultimate peak would signal that he/she is. On the other hand, Portes & Beyssade (to appear) have suggested that in both affirmations and questions, a context of a potential disagreement between interlocutors, the difference between an H+!H\* pitch accent (a fall from the penultimate peak) and an H\*+L<sup>1</sup> pitch accent (a rising-falling

pitch accent towards the accented syllable) would convey a stronger projected disagreement for the former than for the latter, regardless of the boundary tone (L% or H%). In any case, within the framework of the Autosegmental Metrical theory of intonation, the contrast between f0 patterns that have a final rise or fall and f0 patterns in which f0 rises or falls from a penultimate peak can be attributed to the specification for the pitch accent. Specifically, f0 patterns in which the f0 rises toward the accented syllable have an H\* tone while f0 patterns with a penultimate peak are analysed as a sequence of H+!H\* (note that the corresponding tonal label used by Post, 2000, is H+H\* and not H+!H\*<sup>2</sup>). Figure 1 illustrates the two pitch accent types in a rising contour.

FIGURE 1

### **Basics of French intonation**

Despite the ongoing debate on French prosodic structure, there is a general agreement on a number of aspects of French prosody. First, descriptions of French intonation traditionally recognise a system of oppositions between rising, rising-falling and falling f0 patterns (respectively H\* H%, L H\*L% and H\* L% in Post, 2000) which function contrastively at the end of the IP (see also Coustenoble & Armstrong, 1934; Delattre, 1966; Armstrong & Jones, 1967; Fónagy & Bérard, 1973; Mertens, 1987, 1992; Leach, 1988; Di Cristo & Hirst 1996; Di Cristo, 2000; Jun & Fougeron, 2000, 2002; Post, 2000, Portes, 2004). Second, in much work on French intonation, at least two levels of phrasing are usually defined: the Intonation Phrase (IP) and a smaller level, referred to by various names (e.g., ‘Accentual Phrase’ or AP in Jun & Fougeron 1995, 2000, 2002; Welby, 2006; Michelas & D’Imperio, 2012; D’Imperio & Michelas, 2014; ‘Phonological Phrase’, Verluyten, 1982; Delais, 1994, 1995; Post 2000)<sup>3</sup>.



Finally, researchers also generally agree that APs are typically realised with final rise, the peak of which is associated to the metrically strong syllable, and an optional additional rise near the beginning of the AP, although they define the initial rise differently. In Post's account of the phonology of French intonation (Post, 2000), both initial and final rises are treated as pitch accents. In her account, intonation contours are captured by an inventory of two pitch accents  $H^*$  and  $H+H^{*4}$  and an optional inter-accentual L tone. The IP-medial pitch accent is always  $H^*$  but the IP-final pitch accent can be either the monotonal  $H^*$  or the bitonal  $H+H^*$ . Although the two  $H^*$  and  $H+H^*$  pitch accents can be followed by either an  $L\%$  or  $H\%$  boundary tone in Post's intonation system, the  $H+H^* H\%$  sequence did not appear in her data. Moreover in her model, a low tone, generally aligned with the preaccentual syllable, could be inserted between two high starred tones at the phonological surface level. The crucial point about the L-insertion is that it blocks the iterative downstep of subsequent  $H^*$  peaks that takes place within the IP in the context of a  $L\%$  boundary tone. Hence, when there is no low tone intervening between two H tones, the second H tone is automatically lowered in the case of an  $L\%$  boundary tone. That is, the high starred tone is implemented phonetically as a downstepped high tone when it immediately follows another high tone in the same IP. By contrast, when a sequence of two  $H^*$  tones is followed by an  $H\%$ , the downstep is blocked regardless of the insertion of a low tone between the two.

Concerning the structure of the French AP, the crucial point of Post's model is that, although a structural distinction due to the linear position of the accent in the prosodic structure exists, both the initial and the final rises are considered to be pitch accents. However, other studies in the field provide strong evidence that initial and late rises are structurally different in French (Jun & Fougeron, 2000, 2002; Welby 2002, 2003, 2006, Portes et al., 2012). Jun and Fougeron (1995, 2000, 2002) were the first to propose a French model of intonation in the framework of the Autosegmental Metrical theory of intonation that

distinguishes between AP-initial and AP-final pitch patterns at the Accentual Phrase level (L Hi vs. L H\*). In Jun & Fougeron's account, the default AP tonal pattern has the underlying L Hi L H\* structure with L H\* being realised as H\* or L\* as a surface variant. When there is not enough time to realize all four tones of the default L Hi L H\*-pattern, the model also observes five additional surface shapes formed by the absence of one or more tones: L L H\* when Hi is deleted, L Hi H\* when the second L is deleted, Hi L H\* when the initial L is deleted and L H\* when both Hi and the following L are deleted (Jun & Fougeron, 2002), as illustrated in Figure 2.

#### FIGURE 2

In this account, the function of Hi is to be part of an AP-initial accent (L Hi), independently of any pragmatic meaning. Hi is typically realised on the first or second syllable of the first content word of the AP and is sensitive to the length of the AP, appearing more often when the AP contains at least three content word syllables. For instance in an AP containing a one-syllable function word and a three-syllable content word, Hi is expected to be realised either on the first or second syllable of the content word. Concerning H+ <sup>5</sup>, Jun & Fougeron (2000) describe various contours showing a penultimate peak when the utterance has the meaning of implicature, list, and calling contour (when followed by a mid plateau) or incredulous cliché (when followed by a fall-rise contour). In those cases, the penultimate H (when it is clearly not Hi) was all analyzed as an H\* located on the penultimate syllable. Since in this account the penultimate H can be considered as Hi or H\*, it is not clear whether the penultimate H can be considered to be a pitch accent or not. Note that in Jun & Fougeron's model of French intonation, the pitch accent does not have any meaning specific a type as in English or

German. Instead, the main function of pitch accent is to make the words prominent and to demarcate the right boundary of an AP. In their 2000 model, the difference in pragmatic meaning was modelled by the different location of H\* at the end of IP. That is, H\* on the penultimate syllable of an IP delivered ‘implicature’ meaning.

### **Aims of the study**

As we mentioned above, there are no experimental data confirming the link between the realisation of the penultimate peak contour and speaker involvement in French. Thus, the main goal of the current study was to test whether, French speakers use the contrast between H\* and H+!H\* at the end of the utterance to signal speaker commitment. We build on previous research on French intonation suggesting a link between the presence of an unaccented penultimate peak at the end of the utterance and uncertainty on the part of the speaker. Given that pitch accent types have been shown to convey speaker commitment in a wide range of languages, we hypothesised that French speakers would use the pitch accent of the AP in IP-final position in French to distinguish between questions for which the speaker has no particular belief with respect to the answer (unbiased declarative question context) and questions for which the speaker believes the proposition to be false (negatively-biased declarative question context). In other words, our hypothesis is that the H\* H% rising contour, which is preferred for broad-focus questions, will be realised with an additional f0 peak on the syllable preceding the last syllable (i.e., as an H+!H\* H% pattern) when speakers check information they believed to be false at the time of the utterance. Building on Savino and Grice’s (2011) finding of an intonationally encoded difference between positively-biased and negatively-biased questions in Bari Italian, we considered the possibility that negatively-biased yes-no questions might not be analysed as the same pragmatic category as positively-

biased yes-no questions since the speaker is not asking for the confirmation of shared information. Rather, in negatively-biased questions, the speaker shows disbelief and challenges the interlocutor's assumption that the information is shared. This lack of speaker commitment has also been described as incredulity in the literature (Lieberman, 1975; Pierrehumbert & Steele, 1987; Hirschberg & Ward, 1992; Bartels, 1999; Portes & Beyssade, to appear) since speakers partially repeat what has been previously uttered by the interlocutor and signal varying shades of doubt or surprise. Table 1 gives an example of an appropriate context for the unbiased yes-no questions, the positively-biased yes-no question, and the negative question.

#### TABLE 1

Not surprisingly, the phrase *Yves a revendu le guéridon* 'Yves resold the table' uttered with a H\* H% pattern in the contexts provided in Table 1 conveys that the speaker has no expectation with respect to his/her interlocutor's answer (unbiased yes-no questions). Note also that, in line with previous studies on tag-questions (Di Cristo & Hirst, 1996; Jun & Fougeron, 2000), French speakers also use the H\* H% contour to encode questions for which they believed the proposition to be true (positively-biased yes-no questions). Here, we hypothesized that the same sentence uttered with an H+!H\* H% pattern (i.e., an additional high leading tone on the syllable preceding the syllable bearing the pitch accent) would convey incredulity with respect to content already evoked by the interlocutor.

As a secondary goal of this paper, we were also interested in looking at the influence of the presence or absence of a penultimate peak on the internal structuring of the AP. Thus, we asked what patterns are observed when a penultimate H peak is produced in APs containing a 3-syllable content word and what phonetic realisations can they take. To do so,

we focused on two aspects: 1) whether an initial H target could be produced before the penultimate H peak and 2) the acoustic properties of the penultimate H peak in terms of duration and scaling ( $f_0$  height) of the penultimate syllable.

To address the question of the link between the realisation of the penultimate peak contour and speaker involvement, we examined the tonal realisation of IP-final APs in two pragmatic contexts: questions for which the speaker had no particular belief about the propositional content of his/her proposition (unbiased yes-no questions) vs. questions for which the speaker believes the proposition to be false (negatively-biased yes-no questions). In a production experiment, participants had to produce target sentences that could appear in both contexts. We performed prosodic annotations using the labels from Jun & Fougeron (2000, 2002), as well as an additional label, H+!H\*, and acoustic analyses of duration and tonal scaling. We present the results from these analyses in two parts. The first main part of the Results section concerns the tonal patterns found in the two pragmatic contexts. We expected that speakers would prefer a rising contour excluding the presence of an additional H target on the penultimate syllable for unbiased questions (i.e., an H\* H% pattern) while they would mainly produce an additional high leading tone on the syllable preceding the nuclear one (i.e., a H+!H\* H% pattern) for biased ones. Apart from the presence/absence of the additional penultimate H target due to the high leading tone, AP surface shape variations concerning the presence vs. absence of an early H tone near the beginning of the AP were also reported according to Jun & Fougeron's inventory (Jun & Fougeron, 1995, 2000, 2002). In the second part of the Results section, we present the acoustic analyses that allowed us 1) to verify that the penultimate  $f_0$  peak was unaccented and 2) to specify the scaling of the penultimate H peak. Since syllable lengthening is one of the best known correlates of accentuation in French (e.g., Padeloup, 1990; Jun & Fougeron 2000, 20002; Post, 2000; Michelas & D'Imperio, 2012), we first hypothesised that the penultimate syllable would not

be lengthened regardless of the presence of a high leading tone. Second, we also investigated the scaling of the penultimate H peak. In Post's model, in a sequence of two accentual H\* peaks within the same IP, the second H\* tone is lowered due to iterative downstep when followed by an L% boundary tone at the end of the IP (as well as in the absence of an L tone between the two Hs) but not when followed by an H% final boundary tone. Although our study concerns non-accentual H peaks, we analysed the scaling of the penultimate H depending on the final boundary tone produced by speakers. Given that the H peak preceding the penultimate H could be either an accentual H peak (i.e., the preceding H\*) or a non-accentual H tone (i.e., an Hi tone according to Jun & Fougeron 2000, 2002), we also included the type of preceding H in our scaling analyses.

## **METHOD**

### **Participants**

Fourteen French native speakers (2 men and 12 women) took part in the experiment. They were between 18 and 42 years old. At the time of recording they were graduate and postgraduate students at Aix Marseille University. None of them had any known speech or hearing problems and they were naïve with respect to the purpose of the experiment. The participants all spoke Standard French but originated from different parts of France (6 Northern French speakers and 8 Southern French speakers).

### **Stimuli**

A set of 11 pairs of subject-verb-object utterances was designed. All utterances contained a

Subject made of a 1-syllable first name, a 4-syllable transitive verb composed of an auxiliary and a past participle and a 4-syllable object composed of a 1-syllable determiner and a 3-syllable noun (e.g., *Yves a revendu le guéridon* ‘Yves resold the pedestal table’). Sentences were constructed so that the tonal contrast under investigation (H\* vs. H+!H\*) would always occur on the object. All utterances contained all or mostly sonorants to minimise disruption of the f0 contour and facilitate the tonal analysis. A total of 22 target sentences were designed.

Participants were first shown a written context on a computer screen. They were told to silently read the context. Two sentences then appeared on the screen (i.e., the target sentence + an additional sentence). Participants were asked to read both sentences aloud. While target sentences were strictly identical across conditions, contexts and additional utterances were taken from one of the two conditions under investigation (i.e., unbiased yes-no question context and biased yes-no question context). In the unbiased yes-no question context (see (1) below), the participant was explicitly asked to question his/her fictitious interlocutor about a given fact without expecting a particular answer. For the negatively-biased question context, the participant was explicitly asked to call into question what his/her interlocutor had just said (e.g. (2)). An additional sentence differing with respect to the pragmatic context followed each target sentence and aimed to reinforce the contrastive interpretation of the two pragmatic contexts. For the unbiased declarative question context, this additional utterance consisted of an additional information-seeking question such as *A-t-on besoin de le mettre en vente à nouveau ?* ‘Or do we need to place it on sale again?’. For the negatively-biased question context, the additional utterance consisted of an assertion which reinforced the doubt of the speaker (e.g., *Mais je l’ai vu dans le garage il y a quelques minutes* ‘But I have seen it in the garage a few minutes ago.’).

(1) Unbiased yes-no questions

*Context: Votre amie et votre frère, Yves, viennent juste de rentrer d'un vide grenier auquel ils participaient. Vous interrogez votre amie sur ce que votre frère a réussi à vendre:*

‘Your friend and your brother, Yves, are back from local auctions. You are asking your friend about what Yves has sold.’

*Sentences to be produced by the speaker:*

Target sentence: *Yves a revendu le guéridon?* ‘Yves resold the table?’

Additional sentence: *Ou devons-nous le remettre en vente?* ‘Or do we need to place it on sale again?’

(2) Negatively-biased yes-no questions

*Context: Votre amie prétend que votre frère, Yves, a vendu à un vide grenier le guéridon Louis XVI qu'il a hérité. Vous soupçonnez votre amie de se tromper car vous venez d'apercevoir ce meuble dans le garage. Vous mettez en cause ses propos:*

‘Your friend is pretending that your brother, Yves, resold at auctions the Louis XVI table he inherited. Since you have just seen the pedestal table in the garage, you are sure that your friend is making an error. You call into question what your friend has just said.’

*Sentences to be produced by the speaker:*

Target sentence: *Yves a revendu le guéridon?* ‘Yves resold the pedestal table?’.

Additional sentence: *Mais je viens de le voir dans le garage!* ‘But I have seen it in the garage a few minutes ago.’



In both types of target sentences, the pitch accent associated to the IP-final AP of the sentence to be produced (i.e., the target pitch accent) is not a marker of contrastive information. This allowed us to ensure that the target pitch accent encoded only speaker expectations rather than a combination of speaker expectations and the contrastive information status. Two counter-balanced lists were created so that the two different contexts for the same target sentence appeared in different lists. Half of the participants were run on List 1 and the other half on List 2. Within each list the order of presentation was random. In order to increase statistical power, each sentence was presented three times in the same pragmatic context for each of the 14 speakers. There were a total of 462 tokens: 11 sentences  $\times$  3 repetitions  $\times$  14 speakers.

### **Task and procedure**

Participants were tested individually in a sound attenuated room at the Laboratoire Parole et Langage (LPL). They were seated in front of a computer with headphones. They received written instructions. They had first to silently read the context that appeared on the computer screen. They then had to press the space bar of the keyboard to make the two sentences (target sentence + additional sentence) appear. They were told to read the two sentences as fluently as possible at a normal speed and to press the space bar again to go on to the next context. The auditory stimuli were stored at a sampling rate of 16kHz and were presented over Sennheiser HD 212Pro headphones at a comfortable listening level. Participants were recorded onto digital audiotape (DAT) at 64kHz downsampled to 20kHz. Participants completed 6 practice trials before moving on to the critical trials.

### **Data analyses**

The sound files were segmented and each utterance was saved as a separate file. F0 curves and spectrograms were created using Praat (Boersma & Weenink, 2013). Each utterance was first phonetically segmented by means of Easy align (Goldman, 2007). We then verified the boundaries placed through the automatic procedure by inspecting both waveforms and spectrograms. We also manually labelled the IP-final pre-accentual penultimate syllable and the accented syllable. We then performed a prosodic annotation. The prosodic annotation is illustrated in Figure 3, using the following approach:

- 1- The first author (a native speaker of French) manually labelled the last AP of the utterance (i.e., the final AP) and the final boundary tone (L% and H%) based on visual and auditory inspection of the f0 curve.
- 2- We checked for the presence of an H+!H\* or H\* pitch accent on the last AP within the IP using acoustic criteria.
- 3- Following Jun & Fougeron's analysis of French intonation (Jun & Fougeron, 2000), we also checked for the presence of an Hi tone in the last AP within the IP using acoustic criteria. Our procedure was as follows.

First, we labelled the following targets:

L1: A low inflection point or f0 minimum near the beginning of the IP-final AP

Hi: An f0 peak in one of the first two syllables of the IP-final AP (including the determiner).

H+: An f0 peak in the penultimate syllable of the IP-final AP

H5: An f0 peak in the last full syllable (or just beyond it) of the AP before the IP-final AP.

The H tones corresponding to f0 maxima were manually tagged. We used a manual and not

automatic detection of f0 maxima to ensure that f0 maxima corresponded to real phonological H target and not to anomalous f0 points or microprosodic effects. Given that they did not always correspond to f0 minima, early L tones (labelled L1) were first tagged applying a commonly used automatic procedure (see for example Pierrehumbert & Beckman, 1988; D’Imperio, 2000; Frota, 2002; Welby, 2003, 2006). According to this procedure, reference points around the region of the low early inflection points were tagged. The early L were then calculated and inserted automatically using a series of scripts including both Praat and R scripts (R Development Core Team, 2011). The automatic elbow labelling was then visually inspected, and obvious errors in elbow placement were hand-corrected for cases where the elbow formed a sharp angle and the algorithm had clearly chosen an elbow position on the basis of anomalous f0 points (the same procedure was used in Welby, 2006). Note that an early elbow was present within each target APs of our corpus. Once the prosodic labelling was completed, we automatically extracted the duration of the penultimate and final syllables of IP-final APs. F0 values corresponding to target features were also automatically extracted using Praat scripts. Following acoustic criteria used in Astésano (2001) for the pitch accent detection, we considered that an Hi and/or an H+ was actually produced by the speaker if its f0 value (measured in hertz) was at least 10% higher than that of the preceding early L. Thus, for all speakers, Hi and H+ were extracted only if these tones reached an f0 value 10% higher than that of the preceding early L. Note that in cases in which an Hi tone was present before the H+ tone, we observed two types of patterns. First, we observed cases in which the f0 continued at the level of the peak in the preceding Hi tone and rose in the final syllable of the IP (illustrated in Figure 3 (a)). We also encountered cases in which an elbow (labelled ‘el’ in Figure 3 (b)) was present between the two H tones. Since our data contained consonants such as /b/ in Figure 3(b) and our target APs always contained 3 content-word syllables, we are not sure whether this elbow constitute a real L phonological target or not (see the Discussion

section). We thus calculated the height of the H+ relative to the preceding early L irrespective of the presence of a potential elbow between the Hi and the H+ tone. In addition, in order to evaluate the scaling of the penultimate H tone relative to the preceding H\*, we also annotated the second pitch accent of the IP (H5, since it was often realised in the 5<sup>th</sup> or the 6<sup>th</sup> syllable of the IP).

FIGURE 3

## RESULTS

### Effect of the pragmatic context on the tonal patterns

Prosodic annotations revealed that negatively-biased yes-no questions were consistently produced with an f0 peak in the penultimate syllable of the IP-final AP leading to the realisation of an H+!H\* pitch accent in this context. Figure 4 shows the types of pitch accent produced (H+!H and H\*) according to the the two pragmatic contexts (unbiased and, negatively-biased yes-no questions).

FIGURE 4

To test if the pragmatic context had a significant effect on the pitch accent type produced by participants, we used a mixed effects logistic (MLM) regression model. Our binary dependent variable was the pitch accent type with values coded as 0 (for occurrences including a penultimate H peak, i.e., H+!H\* pitch accent) or 1 (for occurrences without a penultimate H peak, i.e., H\*). The binary explanatory variable was the pragmatic context (unbiased or biased question). Speakers and Items were also included in the model as random factors. The model

was fitted using the GLM function in R (R Development Core Team 2010). It included 462 values. In line with our hypothesis, the pragmatic context had a significant effect on pitch accent types produced by participants. Specifically, participants produced more H+!H\* pitch accents on the IP-final AP in the negatively-biased question context and more H\* pitch accents in the unbiased question context ( $\beta=-4.2617, se=0.43, z=-9.913, p<0.001$ ). Interestingly, this penultimate peak contour was produced either with an H% (67% of cases, see Figure 1 (b)) or L% (33% of cases, see Figure 5) final boundary tone. Table 2 gives the number of IP-final contours including a penultimate peak produced by participants depending on the type of final boundary tones.

TABLE 2

FIGURE 5

We also checked for the presence of an Hi tone before the penultimate peak. Table 3 shows the number of IP-final AP tonal patterns produced by participants depending on the presence of the initial H tone (Hi tone) and the type of the IP-final boundary tone (H% vs. L%).

TABLE 3

APs tonal patterns were more often realised without the presence of an Hi tone near the beginning of the AP (55.9% of all productions when the pattern did not include a penultimate H and 14.9% of the time when the pattern included a penultimate H for pitch patterns ending with an H% final boundary tone). Interestingly, the presence of a penultimate H peak did not block the realisation of an Hi tone near the beginning of the AP since we found 43 cases in which the penultimate H was preceded by an Hi tone (32 patterns ending with an H% final

boundary and 11 patterns ending with an L% boundary tone). An example of an H\*L% pattern and Hi H\*L% pattern are given in Figure 6.

FIGURE 6

### **Acoustic properties of the penultimate peak contour**

In addition to prosodic annotations, we performed acoustic analyses. First, we used a linear mixed model to test whether the duration of the penultimate syllable differed depending on the pitch accent type (H\* vs. H+!H\*). The LMM was fitted on the logarithms of duration of the syllable with the pitch accent type as a fixed effect. Additionally, Speakers and Items were included in the model as random factors. The model included 462 values. In line with our hypothesis, the duration of the penultimate syllable was not different depending on the pitch accent type ( $\beta=-0.00715$ ,  $se=0.01707$ ,  $t=-0.041$ ,  $pMCMC=0.711$ ).

Secondly, in order to compare the scaling of the penultimate peak relative to the preceding H peak, we fitted a second LMM on the logarithms<sup>6</sup> of the f0 values. We included type of peak (penultimate H peak or preceding H peak), the type of final boundary tone (H% or L%) and the types of preceding H peak (H5 or Hi) as fixed factors, and Speakers and Items as random factors. The model included 303 values corresponding to productions with a penultimate H peak. Figure 7 illustrates the scaling of the penultimate H peak (in white) and the preceding H peak that could be either H5 or Hi (in black) depending on the final boundary tone (L% or H%).

FIGURE 7

The LMM showed that, when preceded by H5 and followed by a L% boundary tone, the logarithms of f0 values of the penultimate H peak were not significantly different from the logarithms of f0 of the preceding H ( $\beta=-0.01622$ ,  $se=0.02655$ ,  $t=-0.61$ ,  $pMCMC=0.5598$ ). In order to test the other contrasts of interest, e.g., the difference between the log of penultimate H peak and the log of the preceding H when the penultimate H peak was preceded by H5 and followed by H% (and not L%), the 3×2 factor design was converted to a 1×8 factor design. Contrasts of interest were performed using the MASS package and are shown in Table 4.

#### TABLE 4

Crucially, as illustrated in Table 4, the multiple comparisons showed that the penultimate H was never significantly lower than the preceding H regardless of the final boundary tone and the type of preceding H.

## DISCUSSION

The results of the present study show that intonational contrasts can signal the speaker's belief about the certainty of the proposition expressed. Our results also have a number of implications about French intonational phonology.

### **Pitch accents as encoders of speaker commitment in French**

Our goal was to examine whether speakers use the H+!H\* pitch accent to represent negative bias (vs. positive or neutral bias) toward the proposition of a question. The results of our production study showed that negatively-biased questions consistently exhibited an additional

unaccented peak on the penultimate syllable (i.e., an H+!H\* H% pattern) while unbiased questions were often realised with a rising pattern toward the accented syllable (i.e., an H\* H% pattern). Following Post's account of French intonation, we modelled the difference between the two intonation contours by a difference in pitch accent types. This relationship between pitch accent types and speaker commitment is particularly interesting for French, since unlike many other Romance languages or Germanic languages, in French, pitch accents do not just mark prominence. Instead, they mark both the prominence of a word in a phrase post lexically and the right edge of a prosodic unit, the AP (Jun, 2005). Our results provide the first evidence that French speakers use the last pitch accent of an Intonation Phrase to mark commitment.

In addition, our study adds to the body of evidence showing that the difference between positively-biased and negatively-biased questions can be intonationally encoded. As described above, most previous descriptions of French intonation have claimed that the distinction between unbiased questions and positively-biased questions is not intonationally marked since both total (i.e., unbiased) questions and confirmation (i.e., positively-biased) questions are produced with final rises (i.e., a H\* H% pattern; Di Cristo & Hirst 1993, 1995; Di Cristo, 1998; Post, 2000). In line with Fonagy & Bréard (1973) and Portes & Beyssade (to appear), our results show that French speakers intonationally encode the contrast between unbiased and negatively-biased questions. Furthermore, in line with Savino & Grice (2011), our results also support the idea that positively-biased and negatively-biased questions are two distinct categories of pragmatic contrast: the speaker is not asking for confirmation of shared information, rather he or she is showing disbelief and challenging the interlocutor's assumption that information is shared.

In our data, the patterns including a H+!H\* pitch accent could be produced either with an H% final boundary tone (67% of the patterns that included an H+!H\* pitch accent) or an



L% final boundary tone (33% of our participants productions that included an H+!H\* pitch accent). This is in line with previous research on French intonation that have shown that questions can be produced with either an L% or H% final boundary tone. For instance, in Delais-Roussarie et al. (to appear), elicited neutral questions were realised with a rising-falling nuclear configuration (L H\* L%) or with a rising nuclear configuration (L H\* H%) in the same pragmatic context. A recent study (Portes & Beyssade, to appear) inspired by Steedman (2003) on American English proposes that the appearance of an L% vs. H% boundary tone contour may be due to a difference in speaker's assumed responsibility towards the proposition at issue in the utterance. More specifically, Portes & Beyssade (to appear) propose that an H% final boundary tone signals to the addressee that the speaker is allocating the responsibility of putting the content of the utterance into the common ground, while in the case of an L% boundary tone, it is the speaker who assumes this responsibility. According to this hypothesis, in the case of H+!H\* L% and H+!H\* H%, the choice of the H+!H\* pitch accent (rather than H\*) signals a speaker's commitment to the content of his/her utterance while the choice of the final boundary tone depends on whether the speaker cedes or not the responsibility to add the proposition to the common ground. Note that this remains to be tested. Further research is thus necessary to evaluate whether the use of the L% vs. H% pitch accent is meaningful in these pragmatic contrasts in French.

### **Implications for models of French intonation**

First, an important result of our study is that it provides evidence for the H% boundary specification after an H+!H\* pitch accent in French. As mentioned in the Introduction above, although the sequence H+!H\* H% is not prohibited in Post's intonation system, it did not

appear in her data. By contrast, we observed that the H+!H\* pitch accent observed could be followed by an H% boundary tone.

Second, our data suggests that, like a final H\* pitch accent, the H+!H\* pitch accent could be preceded by an early rise, L Hi. The realization of an Hi tone before the penultimate H is important since without it, the penultimate H could be interpreted as Hi or H\* in Jun & Fougeron's model (2000, 2002). That is, if f0 is high from Hi to penult, i.e., if there is a high plateau (with no intervening L), the contour can be analysed as the L Hi H\* AP pattern, thus not supporting the H+!H\* analysis. An argument favouring the existence of an AP pattern including both an Hi tone and penultimate H tone in French might be found in the existence of an L target between the Hi tone and the penultimate H. However, in our study, APs in IP-final position contained a small number of syllables (i.e., APs containing a 3-syllable content word). We therefore did not have many examples of Hi H+ or Hi L H+ sequences. Moreover, because our data contained voiced obstruents in the syllable between Hi and H+ syllables, we cannot be sure whether the elbows we found in the f0 curve corresponded to real L phonological targets or to segmental perturbations (see Figure 3b). Additional experiments including APs containing a different number of syllables (including longer APs) will be necessary to determine whether the L Hi L !H+H\* pattern is allowed in French.

Although our experimental results are not sufficient to determine whether a French AP can contain both an Hi tone and a penultimate H, there are three reasons why we favour an analysis in which H+ is different from both Hi and H\*. Although we did not find many examples with both Hi and H+, about 10% of our data contained H tones on both the penultimate and the first or second syllable of the last AP (6.9% before H% and 2.3% before L%). This means that we need to model two phonological H targets before the final H\*, and the first H (not the second one) should be Hi in Jun & Fougeron's account. Second, the acoustic analyses revealed that the penultimate H is an unaccented peak (thus it cannot be

considered as H\*). Indeed, the acoustic analyses revealed that the penultimate syllable was not significantly longer when the H leading tone of the H+!H\* syllable was produced on that syllable than when it was not (such as in case of an H\* contour). Additionally, a scaling analysis of the penultimate H peak did not reveal downstep phenomenon between the penultimate peak contour and the preceding H peak (that could be either the preceding pitch accent, H5, or an initial H peak, Hi, in our data). Following Post (2000), if the penultimate H is H\*, the f0 of H+ should be lower than that of the preceding H. By contrast, we found that H+ was never lower than the preceding H regardless of the final boundary tone (L% vs. H%) and the type of preceding H (H5 vs. Hi). Finally, our data showed that the H+!H\* pattern was linked to a specific meaning (i.e., the expression of speaker's negative bias toward the proposition of the question sentence), which is different from the Hi function (i.e., to be a part of an initial rise). In our data, speakers used the H+!H\* pitch accent to deliver their negative bias regardless of the boundary tone or the presence or absence of a Hi tone. This means that together the two tones of H+!H\* convey meaning, showing that the H+ is part of a bitonal pitch accent.

In summary, our results, as well as those of Post (2000), appear to support a phonologically contrast between a monotonal H\* and a bitonal H+!H\* pitch accent. These two pitch accent types function contrastively in IP-final position. In addition, our results also provide the first evidence for the third combination of pitch accent and boundary specification proposed by Post's model (i.e., the combination between an H+!H\* pitch accent and an H% final boundary tone) exists in French. Like the H\* pitch accent, the H+!H\* pitch accent observed before an IP prosodic boundary can be followed either by an L% or an H% boundary one.

## **CONCLUSION**

In this paper we have shown that the last pitch accent of an IP encodes speaker commitment in French yes-no questions. The H\* pitch accent indicates that the speaker is not biased toward the answer he/she expects, and the H+!H\* pitch accent signals that the speaker believes the proposition to be false. This result supports the claim that pitch accent types are among the intonational strategies that can be used to prosodically encode speaker commitment toward the content of his/her proposition. Our results also add to the body of knowledge on the phonological contrasts available to French speakers, supporting the existence of an inventory of at least two pitch accents in French (i.e., a monotonal H\* and a bitonal H+!H\* pitch accents) that function contrastively at the end of the Intonational Phrase (IP). These pitch accents can both appear in IP-final position and combine with a H% or a L% boundary tone and can be accompanied by a non-accentual early rise near the beginning of the IP-final Accentual Phrase. Our results did not provide sufficient evidence for the existence of a complex L Hi L !H+H\* AP pattern in French. More research will be required to determine which accentual pattern including a penultimate peak is the most complex one allowed in the language. We know that pitch accent types are processed by listeners of various languages to perform pragmatic analysis of spoken utterances (see for instance Savino & Grice, 2011 for Bari Italian; Vanrell et al., 2013 for Catalan). Further research is needed to determine whether French listeners are able to process pitch accent types to interpret speaker commitment in spoken utterances, and if this is the case, when and how they use it to compute the speaker's intended meaning.

## **FOOTNOTES**

<sup>1</sup>Portes & Beyssade (to appear) code the pitch accent of the fall from the penultimate peak (H+L\*) and the pitch accent of the rise-fall on the last syllable (H\*+L), borrowing from Ladd (2008, p. 122). In their account, each of these pitch accents conveys the idea of the speaker's potential disagreement with the addressee, but this potential disagreement is stronger for H+L\* than for H\*+L. Additionally, each of these pitch accents can combine with a H% or a L%; with L% the speaker takes the responsibility for the truth of the content, while with H% the responsibility for the truth of the content is delegated to the hearer.

<sup>2</sup>In Post's account of French intonation, all patterns in which the f<sub>0</sub> is falling towards the accented syllable, including f<sub>0</sub> patterns with a fall from a penultimate peak, have an H\* (plus a leading H tone in case of a penultimate peak i.e., H+H\*). At the end of the Intonational Phrase, L% leads to an implementation of an H\* at the bottom of the fundamental frequency range. The obvious alternative for this analysis is H+L\*. Since our study did not aim at deciding which of the two options best fits the French data, we followed Ladd's (1996) notation, H+!H\*. Note that the choice between H+!H\* and H+L\* to represent the pitch accent does not affect the study reported in this paper.

<sup>3</sup>Here we adopt Jun and Fougeron's analysis (2002) of the prosodic unit smaller than the IP. In this model, the Accentual Phrase (AP) level is tonally defined. By contrast, in the tonal grammar proposed by Post (2000), this unit is called 'Phonological Phrase' and is defined by morpho-syntactic and metrical structures.

<sup>4</sup>In Post's model, H\* can occur at the end of every PP, but H+H\* can only occur at the end of an IP, i.e., in the last PP of an IP. Post considers both the initial and final rises of the AP in Jun & Fougeron's model as H\* pitch accents. Two H\*s can therefore be found within a unit corresponding to an AP.

<sup>5</sup>For simplicity, throughout the paper we use the notation H+ to describe the first H tone of the H+!H\* pattern.

<sup>6</sup>Note that we used logarithms of f0 values in order to normalize the variability found both within and across speakers.

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## APPENDIX

Target sentences with corresponding additional sentences, unbiased contexts and negatively-biased contexts.



Target sentence	Additional sentence		Unbiased context	Negatively-biased context
	Unbiased context	Negatively-biased context		
Yves a revendu le guéridon	Faut-il qu'on le remette en vente	Mais je viens de le voir dans le garage	<p>Votre amie et votre frère, Yves, viennent juste de rentrer d'un vide grenier auquel ils participaient. Vous interrogez votre amie sur ce que votre frère a réussi à vendre :</p>	<p>Votre amie prétend que votre frère, Yves, a vendu à une vide grenier le guéridon Louis XVI qu'il a hérité. Vous soupçonnez votre amie de se tromper car vous venez d'apercevoir ce meuble dans le garage. Vous mettez en cause ses propos :</p> <p>Vous êtes en train de discuter avec votre collègue de travail. Celui-ci vous confie qu'il a rencontré le nouvel adjutant que Jules, le colonel, vient d'embaucher. Vous êtes très surpris car Jules vous a affirmé qu'il n'y aurait aucune nouvelle embauche cette année. Vous mettez en doute ce que vous affirme votre collègue :</p>
Jules a engagé un adjudant	Est-ce que je continue les entretiens	Je croyais que les embauches étaient gelées pour l'année	<p>Le colonel vous a chargé, votre collègue Jules et vous, d'engager un nouvel adjudant. Après quelques jours de congés, vous interrogez votre secrétaire pour savoir si Jules a trouvé quelqu'un ou si vous devez continuer les entretiens :</p>	<p>Vous travaillez avec une collègue sur la rédaction d'un rapport. Celle-ci prétend qu'Aude, votre patronne, a validé le résumé que vous avez rédigé ensemble hier. Vous la soupçonnez de vous mentir pour rendre le rapport plus rapidement. Vous mettez en doute qu'elle vous raconte :</p> <p>Vous êtes en train de discuter avec votre collègue de travail. Celui-ci vous confie qu'il a rencontré le nouvel adjutant que Jules, le colonel, vient d'embaucher. Vous êtes très surpris car Jules vous a affirmé qu'il n'y aurait aucune nouvelle embauche cette année. Vous mettez en doute ce que vous affirme votre collègue :</p>
Aude a validé le résumé	Peut-on envoyer l'article	Je croyais qu'on devait l'améliorer	<p>Vous êtes en train de travailler avec votre stagiaire sur un projet de recherche. Vous attendez l'aval de votre patronne, Aude, quant au résumé que vous avez rédigé pour soumettre un article. Vous demandez à votre stagiaire ce qu'Aude a pensé du résumé :</p>	<p>Vous travaillez avec une collègue sur la rédaction d'un rapport. Celle-ci prétend qu'Aude, votre patronne, a validé le résumé que vous avez rédigé ensemble hier. Vous la soupçonnez de vous mentir pour rendre le rapport plus rapidement. Vous mettez en doute qu'elle vous raconte :</p> <p>Vous êtes en train de discuter avec votre collègue de travail. Celui-ci vous confie qu'il a rencontré le nouvel adjutant que Jules, le colonel, vient d'embaucher. Vous êtes très surpris car Jules vous a affirmé qu'il n'y aurait aucune nouvelle embauche cette année. Vous mettez en doute ce que vous affirme votre collègue :</p>
Eve a rénové le débarras	A-t-elle besoin d'un coup de main	Hier il était encore dans un état pitoyable	<p>Vous êtes au téléphone avec votre mère qui vous détaille les travaux que votre sœur, Eve, a récemment réalisés dans sa maison. Vous la questionnez pour savoir si elle s'est attaquée au débarras qu'il y a dans son jardin :</p>	<p>Vous êtes en train de discuter avec votre collègue de travail. Celui-ci vous confie qu'il a rencontré le nouvel adjutant que Jules, le colonel, vient d'embaucher. Vous êtes très surpris car Jules vous a affirmé qu'il n'y aurait aucune nouvelle embauche cette année. Vous mettez en doute ce que vous affirme votre collègue :</p> <p>Vous travaillez avec une collègue sur la rédaction d'un rapport. Celle-ci prétend qu'Aude, votre patronne, a validé le résumé que vous avez rédigé ensemble hier. Vous la soupçonnez de vous mentir pour rendre le rapport plus rapidement. Vous mettez en doute qu'elle vous raconte :</p>
Dan a réouvert le magasin	Peut-on voir le résultat	Je pensais que les travaux n'étaient pas finis	<p>Vous êtes en train de travailler avec votre stagiaire sur un projet de recherche. Vous attendez l'aval de votre patronne, Aude, quant au résumé que vous avez rédigé pour soumettre un article. Vous demandez à votre stagiaire ce qu'Aude a pensé du résumé :</p>	<p>Vous travaillez avec une collègue sur la rédaction d'un rapport. Celle-ci prétend qu'Aude, votre patronne, a validé le résumé que vous avez rédigé ensemble hier. Vous la soupçonnez de vous mentir pour rendre le rapport plus rapidement. Vous mettez en doute qu'elle vous raconte :</p> <p>Vous êtes en train de discuter avec votre collègue de travail. Celui-ci vous confie qu'il a rencontré le nouvel adjutant que Jules, le colonel, vient d'embaucher. Vous êtes très surpris car Jules vous a affirmé qu'il n'y aurait aucune nouvelle embauche cette année. Vous mettez en doute ce que vous affirme votre collègue :</p>
Gilles a oublié le romarin	Ne l'as-tu pas rangé quelque part	Je l'ai vu le sortir du sac tout à l'heure	<p>Vous êtes en train de travailler avec votre stagiaire sur un projet de recherche. Vous attendez l'aval de votre patronne, Aude, quant au résumé que vous avez rédigé pour soumettre un article. Vous demandez à votre stagiaire ce qu'Aude a pensé du résumé :</p>	<p>Vous travaillez avec une collègue sur la rédaction d'un rapport. Celle-ci prétend qu'Aude, votre patronne, a validé le résumé que vous avez rédigé ensemble hier. Vous la soupçonnez de vous mentir pour rendre le rapport plus rapidement. Vous mettez en doute qu'elle vous raconte :</p> <p>Vous êtes en train de discuter avec votre collègue de travail. Celui-ci vous confie qu'il a rencontré le nouvel adjutant que Jules, le colonel, vient d'embaucher. Vous êtes très surpris car Jules vous a affirmé qu'il n'y aurait aucune nouvelle embauche cette année. Vous mettez en doute ce que vous affirme votre collègue :</p>
Louis a arrangé les robinets	Est-ce que j'appelle un plombier	Mais ils fuient toujours	<p>Vous arrivez dans votre maison familiale avec votre sœur pour le week-end. Vous lui demandez si son mari, Louis, a eu le temps de s'occuper des fuites d'eau que vous aviez constatées la dernière fois :</p>	<p>Vous travaillez avec une collègue sur la rédaction d'un rapport. Celle-ci prétend qu'Aude, votre patronne, a validé le résumé que vous avez rédigé ensemble hier. Vous la soupçonnez de vous mentir pour rendre le rapport plus rapidement. Vous mettez en doute qu'elle vous raconte :</p> <p>Vous êtes en train de discuter avec votre collègue de travail. Celui-ci vous confie qu'il a rencontré le nouvel adjutant que Jules, le colonel, vient d'embaucher. Vous êtes très surpris car Jules vous a affirmé qu'il n'y aurait aucune nouvelle embauche cette année. Vous mettez en doute ce que vous affirme votre collègue :</p>
Yann a reloué la Chevrolet	Crois-tu que je peux prendre ma grosse valise	Je croyais qu'il s'était acheté une voiture	<p>Vous êtes sur le point de partir avec votre frère Yann et sa femme en vacances. Vous interrogez votre belle-sœur sur le moyen de transport que votre frère a prévu :</p>	<p>Vous travaillez avec une collègue sur la rédaction d'un rapport. Celle-ci prétend qu'Aude, votre patronne, a validé le résumé que vous avez rédigé ensemble hier. Vous la soupçonnez de vous mentir pour rendre le rapport plus rapidement. Vous mettez en doute qu'elle vous raconte :</p> <p>Vous êtes en train de discuter avec votre collègue de travail. Celui-ci vous confie qu'il a rencontré le nouvel adjutant que Jules, le colonel, vient d'embaucher. Vous êtes très surpris car Jules vous a affirmé qu'il n'y aurait aucune nouvelle embauche cette année. Vous mettez en doute ce que vous affirme votre collègue :</p>
Jeanne a démêlé les barbelés	Est-ce que je lui demande de le faire demain	Mais cette clôture est toute neuve	<p>Vous faites un point avec votre contremaître sur les travaux de rénovation de votre ferme. Vous lui demandez si votre employée, Jeanne, a eu le temps de s'occuper de la clôture arrière :</p>	<p>Vous travaillez avec une collègue sur la rédaction d'un rapport. Celle-ci prétend qu'Aude, votre patronne, a validé le résumé que vous avez rédigé ensemble hier. Vous la soupçonnez de vous mentir pour rendre le rapport plus rapidement. Vous mettez en doute qu'elle vous raconte :</p> <p>Vous êtes en train de discuter avec votre collègue de travail. Celui-ci vous confie qu'il a rencontré le nouvel adjutant que Jules, le colonel, vient d'embaucher. Vous êtes très surpris car Jules vous a affirmé qu'il n'y aurait aucune nouvelle embauche cette année. Vous mettez en doute ce que vous affirme votre collègue :</p>
Louise a prévenu le boulanger	Est-ce qu'elle l'a eu au téléphone	Elle m'a demandé de m'en occuper	<p>Vous deviez acheter une grande quantité de pâtisseries pour un petit déjeuner d'affaire qui a été repoussé. Vous demandez à votre secrétaire si votre collègue de travail, Louise, s'est chargée de prévenir le boulanger du changement de date :</p>	<p>Vous travaillez avec une collègue sur la rédaction d'un rapport. Celle-ci prétend qu'Aude, votre patronne, a validé le résumé que vous avez rédigé ensemble hier. Vous la soupçonnez de vous mentir pour rendre le rapport plus rapidement. Vous mettez en doute qu'elle vous raconte :</p> <p>Vous êtes en train de discuter avec votre collègue de travail. Celui-ci vous confie qu'il a rencontré le nouvel adjutant que Jules, le colonel, vient d'embaucher. Vous êtes très surpris car Jules vous a affirmé qu'il n'y aurait aucune nouvelle embauche cette année. Vous mettez en doute ce que vous affirme votre collègue :</p>
Laure a balayé la véranda	A-t-elle eu le temps	Je croyais qu'elle était collée	<p>Laure votre femme de ménage, n'était pas sûre de pouvoir tout faire aujourd'hui. En rentrant chez vous, vous demandez à votre femme/mari ce que la femme de ménage a eu le temps de nettoyer :</p>	<p>Vous travaillez avec une collègue sur la rédaction d'un rapport. Celle-ci prétend qu'Aude, votre patronne, a validé le résumé que vous avez rédigé ensemble hier. Vous la soupçonnez de vous mentir pour rendre le rapport plus rapidement. Vous mettez en doute qu'elle vous raconte :</p> <p>Vous êtes en train de discuter avec votre collègue de travail. Celui-ci vous confie qu'il a rencontré le nouvel adjutant que Jules, le colonel, vient d'embaucher. Vous êtes très surpris car Jules vous a affirmé qu'il n'y aurait aucune nouvelle embauche cette année. Vous mettez en doute ce que vous affirme votre collègue :</p>

## TABLES

Table 1. Appropriate contexts and expected Intonational Phrase-final Accentual Phrase tonal patterns for unbiased, positively- and negatively-biased yes-no questions.

Speaker commitment	Pragmatic context	Sentence	Expected tonal patterns
<b>Unbiased yes-no question</b>	<i>Votre amie et votre frère, Yves, viennent juste de rentrer d'un vide grenier auquel ils participaient. Vous interrogez votre amie sur ce que votre frère a réussi à vendre:</i>  Your friend and your brother, Yves, are back from local auctions. You are asking your friend about what Yves has sold:	<i>Yves a revendu le guéridon? Faut-il qu'on le remette en vente?</i>  Yves resold the table? Or do we need to place it on sale again?	H*H%
<b>Positively biased yes-no question</b>	<i>Votre amie et votre frère, Yves viennent juste de rentrer d'un vide grenier. Quelques minutes plus tôt, votre amie vous a raconté qu' Yves a négocié le guéridon Louis XVI qu'il a hérité. Maintenant qu'ils sont rentrés vous demandez à votre amie ce qu'Yves a finalement vendu.</i>  Your friend and your brother, Yves, are back from local auctions. A few minutes ago, your friend told you by phone that Yves was negotiating the Louis XVI table he has inherited. Now they are back, you are asking your friend about what Yves has finally sold:	<i>Yves a revendu le guéridon? Il a dû en obtenir un bon prix.</i>  Yves resold the table? He must have got a good price.	H*H%
<b>Negatively biased yes-no question</b>	<i>Votre amie prétend que votre frère, Yves, a vendu à un vide grenier le guéridon Louis XVI qu'il a hérité. Vous soupçonnez votre amie de se tromper car vous venez d'apercevoir ce meuble dans le garage. Vous mettez en cause ses propos:</i>  Your friend is pretending that your brother, Yves, resold at auctions the Louis XVI table he has inherited. Since you have just seen the table in the garage, you are sure that your friend is making an error. You call into question what your friend has just said:	<i>Yves a revendu le guéridon? Mais je viens de le voir dans le garage!</i>  Yves resold the table? But I have seen it in the garage a few minutes ago.	H+!H*H%

Table 2. Number of tonal patterns including a penultimate peak produced by participants depending on the pragmatic contexts. Percentages relative to the total number of tonal patterns produced are given in parentheses.

		Pragmatic context	
		Unbiased questions	Negatively-biased questions
H+!H* H%		1 (0.7%)	100 (66.2%)
H+!H* L%		6 (4.0%)	44 (29.1%)

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Table 3. Number of pitch accents produced by participants depending on the type of pitch accent (H\* vs. H+!H\*), the presence of the initial H tone (Hi) and the type of the IP-final boundary tone (H% vs. L%). Percentages of pitch accents relative to the total number of pitch accents produced by participants are given in parentheses.

Final boundary tone	Hi tone	H*	H+ !H*
H%	No	258 (55.9%)	69 (14.9%)
	Yes	20 (4.3%)	32 (6.9%)
L%	No	23 (5.0%)	32 (6.9%)
	Yes	17 (3.7%)	11 (2.3%)

Table 4. Results for multiple comparisons for contrasts other than the one given by the LMM model.

Type of preceding H	Presence of a L tone	Coefficient estimate	Standard error	z value	p (< z )
L%	Hi	-0.02524	0.05176	-0.488	0.980
	H5	-0.04113	0.02169	-1.896	0.212
H%	Hi	-0.05738	0.03592	-1.598	0.373

## FIGURE TITLES

Figure 1. Waveform, spectrogram and f0 contour (superimposed on the spectrogram) of two f0 patterns in which f0 rises toward the accented syllable. An H\* pitch accent is found in the last Accentual Phrase of the Intonation Phrase in (a) while an H+!H\* pitch accent is found in (b). The sentences are: *Jules a engagé un adjudant* 'Jules hired an adjutant' and *Yves a revendu le guéridon?* 'Yves resold the table'.

Figure 2. Six variants surface shapes of the AP observed by Jun & Fougeron's model (2002)

Figure 3. Waveforms, spectrograms, and f0 contours (superimposed on the spectrogram) of two APs in IP-final position including a Hi tone before the H+ tone. In (a), the fundamental frequency continues at the level of the peak in the Hi tone and rises in the final syllable of the IP. In (b), an f0 dip (labelled *el*) between the two unaccented H (Hi and H+) is present. The sentences are *Louise a prévenu le boulanger* 'Louise warned the baker' in and *Aude a validé le résumé* 'Aude validated the abstract'.

Figure 4. Number of pitch accents (H+!H\* vs. H\*) produced by participants depending on the pragmatic context (unbiased vs. negatively-biased yes no questions).

Figure 5. Example of an H+!H\* patterns followed by an L% boundary tone (see footnote 2 for the choice of the H+!H\* pitch accent). The utterance is *Laure a balayé la veranda* 'Laure swept the veranda'.

Figure 6. Examples of an H\* L% pattern (a) and an Hi H\* L% pattern (b). The utterances are *Giles a oublié le romarin* ‘Giles forgot the rosmary’ and *Paul a arrangé les robinets* ‘Paul repaired the taps’.

Figure 7. Logarithms of the f0 values of the penultimate H peak (in white) and the preceding H peak (in grey) depending on the type of preceding H peak (H5 vs. Hi) and the type of final boundary tone (H% vs. L%).

FIGURES

Figure 1

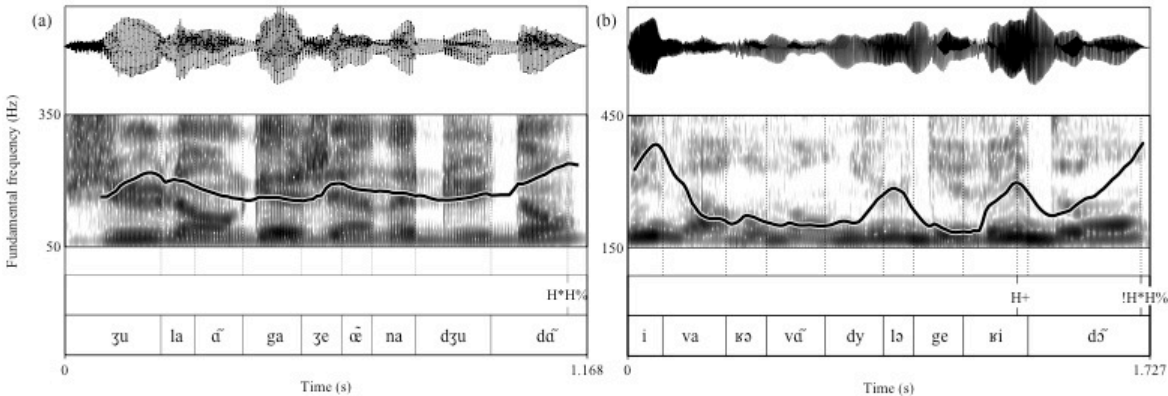


Figure 2

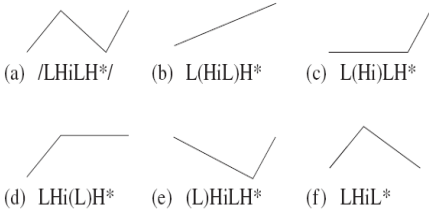


Figure 3

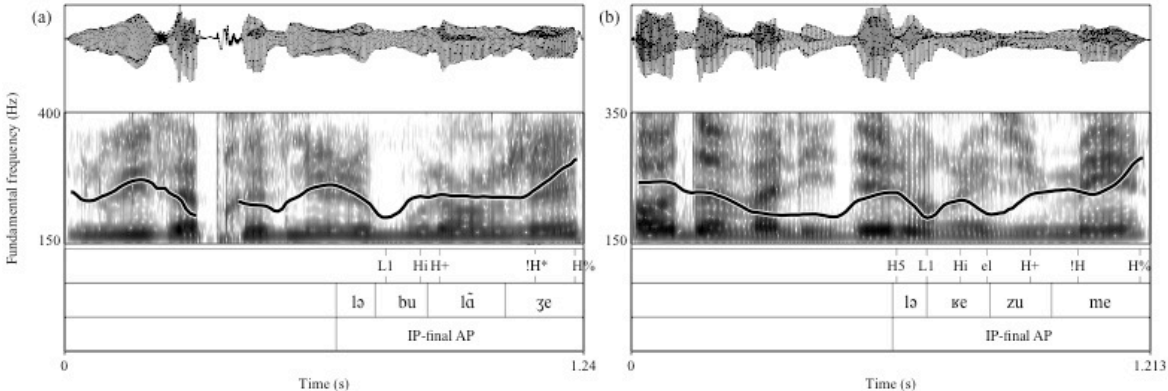


Figure 4

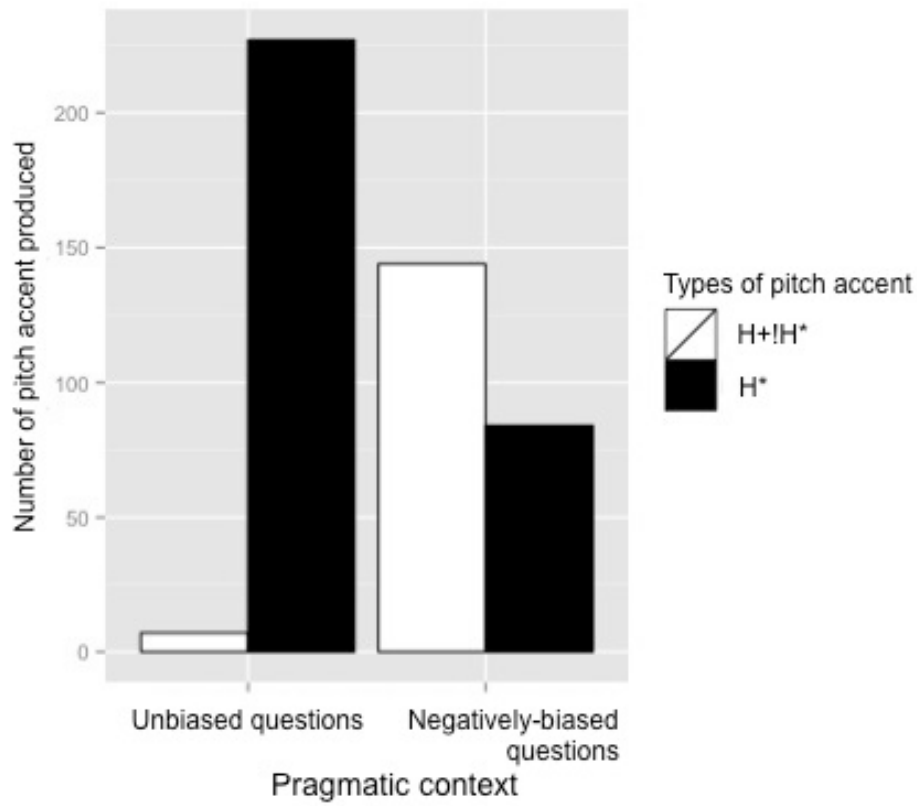


Figure 5

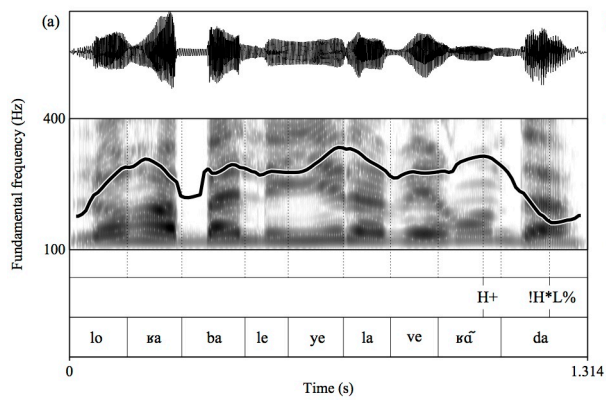


Figure 6



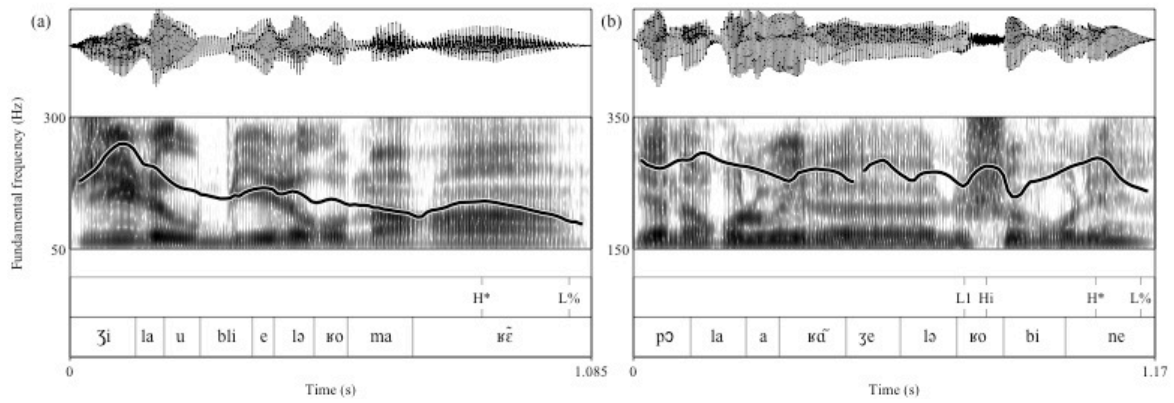


Figure 7

