Intonational contrasts encode speaker's certainty in neutral vs. incredulity declarative questions in French

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Abstract

While recent crosslinguistic studies have shown that the degree of speaker's commitment or certainty is encoded intonationally either in a gradient or categorical fashion, our understanding of how French speakers use Intonational-Phrase (IP) final contours to signal their degree of certainty is limited. This paper investigates the contribution of a penultimate peak contour in French to convey speakers' uncertainty. Participants read target sentences in a neutral vs. incredulity declarative question context. Prosodic annotation revealed that incredulity declarative questions consistently exhibited the presence of an additional f0 peak in the penultimate syllable of the IP which was unaccented. The acoustic analyses showed that the H tone of the unaccented penultimate peak was not downstepped and thus approximately scaled to the same height of the last pitch accent. The findings of this study provide the first quantitative description of a phonological contrast between H*H% and H+ H*H% to signal speakers' certainty in declarative questions in French.

Index Terms: Intonation, penultimate peak, scaling, neutral declarative question, incredulity declarative question, French.

1. Introduction

It is acknowledged that the degree of speaker's commitment or certainty is encoded by final contours. For example in Dutch, the contrast between an information-seeking question (question for which the speaker has no particular bias with respect to the answer he/she expects) and a confirmation-seeking question (question for which the speaker has some bias based on beliefs, expectations, world knowledge information that has become available in the discourse context, [1], [2]) is expressed through a different pitch contour, namely H* L* HH% for neutral questions and H* L+H* LH% for incredulity declarative questions [3]. Similarly, Savino & Grice [4] demonstrated that in Bari Italian, the choice of an L+H* accent rather than an H+L* accent reflects the degree of confidence with which the speaker believes the information to be shared with the interlocutor. Interestingly, recent crosslinguistic descriptions have shown that the speaker's certainty can be marked either categorically (e.g. by two types of pitch accent) or gradually (e.g. by variation in global and/or local pitch range). For example, Catalan and Buenos Aires Spanish appeared to use gradient cues to encode the contrast between information vs. confirmation-seeking question. For instance, [5] showed that what distinguishes these two types of questions in Catalan, is the expanded pitch range that characterized incredulity contours. Specifically, the difference in pitch scaling of the boundary tone HH% appeared to be the strongest cue to distinguish between the two interpretations. [6] found that in Buenos Aires Spanish, incredulity declarative questions have a wider global pitch range than neutral declarative questions.

In French, the contrast between a neutral vs. an incredulity question can be conveyed through at least two strategies. First, as in English, a change in the order of constituents could be used. In this case, a closed-interrogative characterized by subject-auxiliary inversion [7] contrast with incredulity declarative yes-no question questions which use the same form as a statement (as illustrated in Table 1). Another strategy to mark this contrast consists in using prosody rather than subject-auxiliary inversion. In this case, both sentences are declarative questions (they are syntactically identical) and the speaker's certainty is only intonationally marked.

	Syntactic strategy	Prosodic strategy
Neutral context	Maud a-t-elle amené des raviolis? 'Has Maud brought ravioli?'	Maud a amené des raviolis? 'Maud has brought ravioli!?'
Incredulity context	Maud a amené des raviolis!? 'Maud has brought ravioli!?'	Maud a amené des raviolis!? 'Maud has brought ravioli!?'

Table 1. Strategies available to speakers to signal the contrast between neutral and incredulity question context.

In this paper, we analysed French intonation contours in an Autosegmental-Metrical framework presented in [8, 9]. In that framework, we assume that French tunes consist of sequences of Low and High tones. Boundary tones (denoted by T%) mark the prosodic constituent at the Intonation-Phrase level (the highest level relevant to intonation) and accented positions in the utterance are marked by pitch accents (denoted by T*). Traditionally, descriptions of French intonation recognise a system of oppositions between rising (H*H%), rising-falling (H*L%) and falling pitch movements (L*L%) which function contrastively at the end of the Intonation-Phrase (IP, [10, 11, 12, 13]). An additional H+H*L% intonation contour, which appeared to be phonologically distinct from the other three, has also been observed. In this movement, pitch falls from a peak in the penultimate syllable, which is unaccented. Post [13] proposed an analysis in which the distinction between falling movements and movements with a fall from a pre-accentual peak is attributed to the specification of the pitch accent, H* and H+H* respectively. In this analysis, the H+H* pitch accent can combine either with a 0% boundary tone scaled at the same level as the preceding H* tone or with a low L% boundary tone as illustrated in Fig. 1.
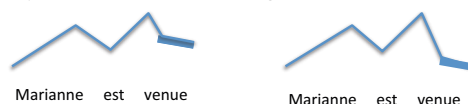

*Figure 1. Phonetic implementation of the fall to mid penultimate peak %LH*LH+H*0% (left) and fall to low penultimate peak %LH*LH+H*L% (right) for the utterance Marianne est venue 'Marianne came' according to Post (2000).*

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While one of the main function of tonal rises is to signal questions in French, it has been proposed that the presence of an unaccented penultimate peak cues detachment on the part of the speaker both in assertion [10, 14, 15, 16, 17], and questions [16, 17, 18]. Specifically, in questions, Fonagy & Bréard [18] suggested that a penultimate peak contour conveys greater uncertainty than a rising movement. While no quantitative findings are presented, Portes & Beyssade [16] have also proposed that a pitch peak on the penultimate syllable in French would convey incredulity about a value already evoked by the interlocutor.

The goal of this study was to investigate whether the presence of an unaccented f0 peak in the penultimate syllable of the Intonation-Phrase encodes the contrast between neutral vs. incredulity declarative questions in French. We hypothesized that H*H% would encode neutral declarative questions whereas H+H*H% would encode incredulity declarative questions (see Fig. 2). Since no experimental data investigated the phonetic and phonological properties of the French penultimate peak contour yet, the secondary goal of our paper was to specify the properties of this contour in terms of scaling (height) of tonal targets.
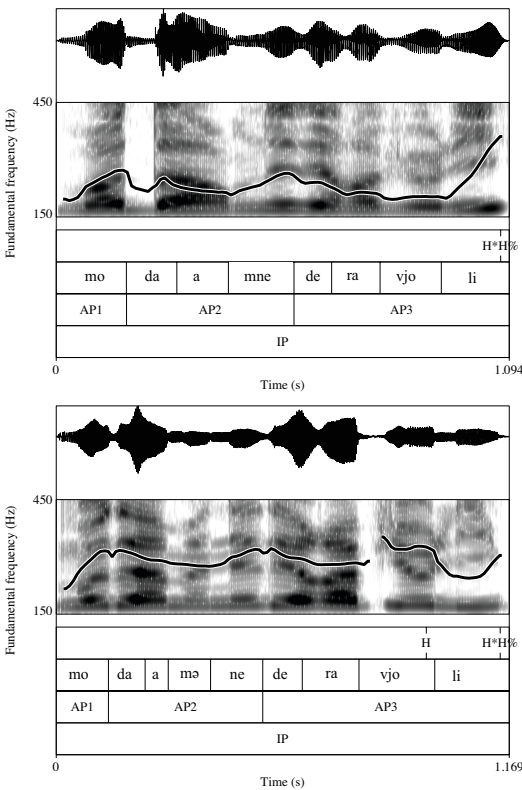

*Figure 2. Two renderings of the utterance Maud a amené des ravioli 'Maud brought ravioli' with a H*H% (top) or a H+H*H% contour (bottom) at the end of the IP.*

2. Method

To investigate the contribution of an unaccented f0 peak on the penultimate syllable of the IP in distinguishing between neutral vs. incredulity declarative questions, we conducted a production experiment. In this task, participants had to produce target utterances that could appear in a neutral or an incredulity declarative question context.

2.1. Speech material

Target sentences consisted of 12 pairs of SVO utterances. All utterances contained a Subject made of a one-syllable first name, a 4-syllable transitive verb and a 3-syllable object (e.g. *Maud a amené des ravioli* 'Maud has brought ravioli'). All utterances were voiced throughout, to avoid any disruption of the f0 contour. Target utterances could appear in two conditions as illustrated in Table 2.

Neutral declarative question context	Incredulity declarative question context
You invited your sister, Maud, for dinner this evening. Your husband is coming in the kitchen to let you know that she has just arrived. You ask him about the meal she brought.	You invited your sister, Maud, for dinner this evening. She promised you that she would bring a *poulet basquaise*, her speciality. Your husband is coming in the kitchen and pretending that Maud has just arrived and has brought ravioli. You seriously doubt that Maud has changed her mind and put into question what your husband has just said.

Table 2. English translation of a sample neutral and incredulity declarative question context for the target utterance Maud a amené des ravioli 'Maud brought ravioli'.

For the neutral declarative question context, the participant was explicitly asked to question his/her fictitious interlocutor about a given fact without expecting a particular answer. For the incredulity declarative question context, the participant was explicitly asked to put back in doubt what his/her interlocutor has just said. An additional utterance that was different according to the two types of context followed each target sentence. For the neutral declarative question context, this additional utterance consisted in an additional information-seeking question such as *Est-ce que je fais chauffer de l'eau? '*Should I boil some water?*'*. For the incredulity context, the additional utterance consisted in an assertion which reinforced the doubt of the speaker (e.g. *Je croyais qu'elle devait cuisiner un poulet basquaise* 'I thought she was going to cook *poulet basquaise'*).

2.2. Participants and procedure

Six native French speakers, five females and one man, voluntarily participated in the recordings. They were between 18 and 34 years old. At the time of recording they were graduate and postgraduate students of 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 (two northern French speakers and four southern French speakers).

Participants received written instructions to read the two utterances (target utterance + additional utterance) at a normal speed as fluently as possible. They were told to silently scan the context before reading the two utterances aloud. Contexts were firstly presented on a computer screen and then participants had to press the space bar to make the corresponding utterances appeared.

Participants were recorded in the sound-proof room of the *Laboratoire Parole et Langage*. Data were stored simultaneously on DAT-tapes and on a PC with a sampling rate of 44.1kHz. Two lists of sentences were created so that

the neutral vs. incredulity version of each utterance appeared in a different list. Each participant was presented with only one list (half of the participants read List 1 whereas the other half read List 2). Within each list, the order of appearance was randomized by participant. Note that, in order to increase statistical power, each sentence was presented three times for each of the 6 speakers. The data result in a total of 216 tokens: 12 sentences x 3 repetitions x 6 speakers.

2.3. Analysis

Individual recordings were segmented and each utterance saved as a separate file. Data were analysed using Praat [19]. Each utterance was first phonetically segmented by means of Easy Align [20]. The first author then manually labeled target syllables by inspecting both waveforms and spectrograms, after hand-checking the automatic segmentation procedure.

Before performing the extraction of target duration and f0 values, we verified that the expected prosodic phrasing was actually produced by the speakers. To do that, Accentual Phrase (AP) and Intonational Phrase (IP) boundaries were manually placed through a ToBI-style annotation scheme. The results of the intonation labelling revealed that all of the 216 utterances were realized as one IP composed of 3 APs (see Figure 2 above). Most of the utterances were produced with a final rising f0 movement though 2.3% of the utterances produced (5 utterances) showed an IP-final falling contour. These utterances were excluded from our analyses.

To study the presence/absence of an unaccented penultimate f0 peak on the penultimate syllable of the IP, we compared the height and the duration of the penultimate syllable of the IP in the neutral vs. incredulity declarative question contexts. First, we manually labelled the penultimate (S8) and last syllable (S9) of each utterance by correcting by hand the syllable phrasing of Easyalign. Second, the maximum f0 values in the region of the penultimate peak syllable and the last syllable (respectively H8 and H9) were first automatically labeled and than corrected by hand by the first author. Finally, in order to investigate the scaling of the penultimate peak, we also labeled the f0 maximum of the first and the second pitch accent within each IP (namely H1 and H5). Once this labelling was completed, segmental durations and f0 values were automatically extracted using Praat scripts.

2.4. Hypothesis and predictions

Our main hypothesis concerned the exhibition of an unaccented f0 peak on the penultimate syllable of the utterances in the incredulity declarative question context. According to this hypothesis, we expected (i) higher f0 values associated to S8 in the incredulity condition relative to the neutral condition, (ii) that the duration of S8 would not be longer in both contexts since lengthening is a known correlate of accentuation in French [12, 13, 21, 22] and (iii) that the H tone of the penultimate peak would not be downstepped and thus scaled approximately to the same height than the last preceding pitch accent (labelled H5) given that the successive pitch accents are downstepped in French within the IP [13, 21].

3. Results

We first investigated the height and the duration of the penultimate syllable in both neutral and incredulity declarative question contexts. Two linear-mixed models (LMM) were fitted, one on the f0 maximum in the region of the penultimate syllable and one on the duration of the penultimate syllable. Both LMM models had the context (incredulity vs. neutral) as fixed effects and speakers and items as random effects. In line with our hypothesis, the effect of the context (incredulity vs. neutral) was highly significant on f0 maximums of the penultimate syllable (β=14.88, se=4.34 t=3.43, pMCMC<0.001). The LMM model included 211 values. The f0 height of the penultimate syllable (H8) is illustrated in figure 4.
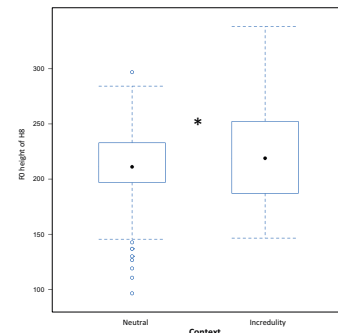

Figure 4. f0 height (in Hz) of the penultimate syllable (H8) depending on the context.

Additionally, as expected, the effect of the context on the duration of the penultimate syllable was not significant (β=10.00, se=0.01, t=0.69, pMCMC=0.45). These results confirm our hypothesis according to which the f0 peak present on the penultimate syllable in the incredulity context was unaccented. To confirm that the higher f0 values observed in the penultimate syllable in the incredulity context were due to the presence of a pitch peak rather than other factors (such as microprosodic effects), we conducted an additional intonational labelling. The result of this labelling is given in the following section.

Following Post's definition of the penultimate peak contour in French, an f0 peak in the penultimate syllable which was perceived as a peak was annotated H+H*. Additionally, we labelled H+H* L% IP-final contours in which pitch falls from an unaccented penultimate peak to low, H+H*0% IP-final contours in which pitch falls from an unaccented penultimate peak to mid, and H+H*H% IP-final contours in which pitch rises from an unaccented penultimate peak. The presence vs. absence of a penultimate peak contour is illustrated in Figure 5.
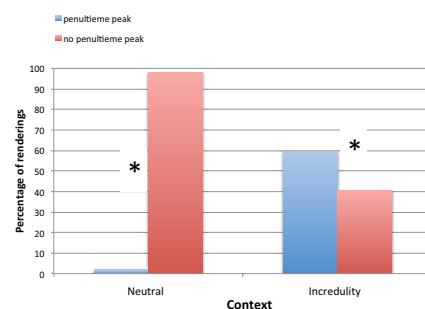

Figure 5. Percentage of productions of a penultimate f0 peak depending on context (neutral vs. incredulity declarative context).

To test if the context has a significant effect on the presence vs. absence of a penultimate f0 peak, we used a mixed effects logistic regression model (MLM mixed model). Our binary dependent variable was the presence vs. absence of a penultimate peak. The binary explanatory variable was Context. Speakers and Items were also included in the model as random factors. The model included 211 values. Participants significantly produced more IP-final contours without a penultimate f0 peak in the neutral context whereas they significantly produced more utterances containing a penultimate f0 peak in the incredulity context (β=4.73, se=0.869 z=5.44, p<0.0001). These results confirmed that the higher f0 values observed in the penultimate syllable in the incredulity context relative to the neutral context were merely due to the presence of an unaccented f0 penultimate peak.

We also analysed the f0 pattern after the penultimate f0 peak. Three types of patterns were observed: a fall after the penultieme peak to low (H+H*L%), a fall to mid (H+H*0%) or a rise (H+H*H%). The percentage of productions of each pattern is illustrated in Table 3.

	⋀⋁	⋀	⌐▬
All speakers	57	10	33
AT	90	0	10
BB	100	0	0
CS	75	0	25
LL	25	75	0
MD2	0	0	100
MG	72	0	28

Table 3. Percentage of productions of H+H*H%, H+H*L% and H+H*0% contours in our data.

Finally, we also measured the scaling of the penultimate peak relative to the preceding pitch accents. To do so, we conducted a LMM model on the height of pitch accents only for utterances containing an unaccented f0 peak (see section 3.2 above for the annotation scheme details). The type of accent (H1, H5 and H8) was included as fixed factor whereas Speaker and Sentence were included as random factors. The results showed that the height of the penultimate peak is not significantly different from the height of the preceding pitch accent (namely H5, β=-6.49, se=6.34, t=-1.02, pMCMC=0.33). Additionally, the penultimate peak, as the preceding pitch accent, was significantly lowered than the first pitch accent within the utterance (namely H1, β=-16.05, se=6.34 t=-2.53, pMCMC<0.05). The model included 177 values. These results confirmed that the penultimate peak was approximately at the same height of the preceding pitch accent and thus free from downstep.

4. Discussion

In the present experiment, IP-final contours in neutral vs. incredulity declarative questions were compared. As expected, declarative questions in a neutral context were produced with an IP-final rising contour (H*H%). Crucially, in line with [16], this production experiment provides experimental evidence that declarative questions in incredulity context were consistently realized with an additional unaccented f0 peak on the penultimate syllables (H+H*H%). This result points out that the difference between the two declarative question types is expressed through the realization of two different intonation contours, namely H*H% for neutral declarative questions and H+H*H% for incredulity declarative questions in French.

The acoustic analyses revealed that the penultimate f0 peak observed in incredulity declarative question contexts was associated to an unaccented syllable. Additionally, we found that the penultimate f0 peak was approximately scaled at the same height as the preceding pitch accent since it was free from downstep affecting subsequent accents within the IP. The results of the intonational labeling also showed that after the penultimate peak, a rise or a fall to mid (but rarely a fall to low) was mainly observed. This results contrast with the description of the French penultimate peak contour found in the literature. Indeed, in a Map task experiment, Post [13] found two types of penultimate peak contour: realizations in which pitch falls to the middle of the range and realizations in which pitch falls to low. Surprisingly, in contrast with our data, she did not notice any penultimate peak contour following by a rising movement. A possible account for this discrepancy concerns the speech material employed in the two studies. While in the present study, the manipulation of the speaker's certainty was one of the aim of the experiment, the Map-Task material analyzed by Post, might induce only a few cases in which the speaker had reasons to doubt about the content of both his/her proposition and/or the proposition of his/her interlocutor.

In our data, speakers produced significantly more IP-final rising contours including an f0 penultimate peak rather than rising contours without f0 penultimate peak. This result supports the claim that phonological contrasts in intonation, together with other linguistic strategies such as subject-auxiliary inversion, can signal the speakers' certainty about the position expressed. These results are in line with what is observed in other languages such as Bari Italian or Dutch in which the speaker's certainty is encoded through distinct intonational contours (see section 1 above).

However the fact that the speakers' certainty appeared to be encoded by an intonational contrast do not exclude that the degree of speaker's certainty could also be gradually encoded. Specifically, regarding our results, we wonder whether an artificially modification of the height of (i) the penultimate peak contour and (ii) the final H% boundary tone would induce differences in the way that listeners would perceive the degree of speaker's certainty. As noticed by [23] most of the studies in the field have relied on production experiments and little is known about the relevance of these intonational cues in perception. Thus, the next steps of our study will be to test (i) whether the presence of a penultimate peak is used by French listeners to distinguish between neutral vs. incredulity declarative questions, (ii) whether a change in the height of the penultimate peak and the final boundary tone affects the way that listeners recognize the degree of speakers' certainty and (iii) whether this degree of certainty is encoded by listeners in a gradient or a categorical fashion in French.

5. Acknowledgements

6. References

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