Pre-focal Rephrasing, Focal Enhancement and Post-focal Deaccentuation in French

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Abstract

This study aims at better describing the acoustic correlates of contrastive focus in French. A corpus was recorded from a male native speaker of French. It consisted of sentences with a subject-verb-object (SVO) structure under four conditions: focus on each phrase (S,V,O) and broad focus. The focal, pre-focal and post-focal constituents were studied separately. The acoustic analysis showed that: a) the pitch of the focal constituent rises, b) that of the surrounding constituents decreases, c) the duration of the focal syllables and of the pre-focal syllable increases, the onset of the focal constituent increasing the most, d) the pre-focal sequence is rephrased, e) the post-focal sequence is deaccented.

1. Introduction

1.1. Aim

Different types of focus have been described in the literature. The present study deals with contrastive focus and the way it is conveyed by prosody in French. In a recent investigation, we studied visible articulatory correlates of prosodic contrastive focus for one speaker. Some acoustic characteristics of the focused constituents were examined in parallel. They were in agreement with other reports in the literature. The present paper aims at providing a more detailed description of the melodic, rhythmic and phrasing correlates of prosodic contrastive focus for this same speaker. More specifically, this study puts forward a number of newly observed phenomena especially on the pre-focal constituent.

1.2. Background

1.2.1. What is contrastive focus?

By contrastive focus we mean the selection by the speaker of a given constituent of the message to be underlined as opposed to another constituent in a paradigmatic comparison (for references see 2.). Contrastive focus is one type of narrow focus. In French, contrastive focus can either be signaled syntactically (the prominent word or phrase is put forward through a syntactic focus construction: a cleft sentence) or prosodically (the prominent word or phrase is put forward through prosodic features such as fundamental frequency (F0), duration and/or intensity). These two ways of signaling focus can be combined, as put forward by Féry in [1].

1.2.2. Description of the model of prosody used

This study was conducted using a phonological model of French prosody. Many phonological models of the prosodic structure of French have been proposed ([2, 3, 4, 5, 6, 7, 8, 9, 10] *inter alia*). Jun & Fougeron's model was used in the present study ([5, 6]). This model agrees with most descriptions of French intonation and uses a transcription system consistent with the widely used ToBI framework ([11]). It features two hierarchical prosodic units. The lower is the Accentual Phrase (AP, right demarcated by the primary stress (H*) and sometimes marked by an initial LHi (Low-High) tonal sequence called the secondary accent). The default tonal pattern of the AP is /LHiLH*/ as realized on the second AP of Figure1a). The higher prosodic unit is the Intonational Phrase (IP) which can preempt the AP level. E.g., if an AP is IP-final, H* is replaced by the boundary tone of the IP (L% or H%) as shown in the last AP of Figure 1.
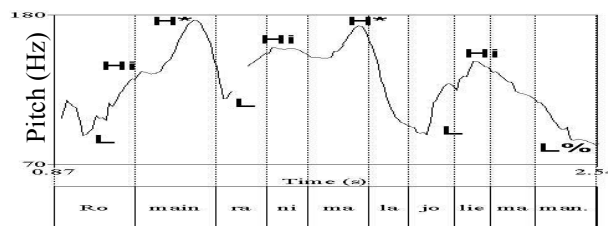

Figure 1: F0 trace for an IP including 3 APs. The utterance was {[Romain]_{AP}[ranima]_{AP}[la jolie maman]_{AP}}_{IP} ('Romain revived the good-looking mother.').

2. Description of the acoustic correlates of contrastive focus in French in the literature

Previous studies of contrastive focus in French have reported several effects on the acoustic characteristics of the focused constituent and its neighbors (e.g. [3, 5, 9, 12, 13, 14]). We will summarize some of the findings.

First, as concerns F0, it has been shown that the focused constituent is marked by a sharp F0 rise followed by a fall. The F0 peak is often aligned with the first syllable but not always. The post-focal constituent has been described as deaccented, i.e. displaying a reduced pitch range with no F0 peaks. Fewer studies have examined the acoustic consequences of focus on the pre-focal constituent. In [14] it is suggested that F0 peaks in this position are lowered.

As concerns rhythmic correlates, it has been reported that duration increases on the focused constituent as a whole. More locally, the duration of the syllable bearing the focus usually increases and the onset consonant of the focused constituent is often longer. Contrary to what is found for F0, the duration of the post-focused constituent does not seem to be affected (the post-focused constituent is not dephrased).

Finally, some studies report that contrastive focus can induce a rephrasing of the utterance.

3. Experimental setup

The corpus consisted of eight sentences with a Subject-Verb-Object syntactic structure (SVO) and with CV syllables. Each sentence was likely to be produced as a single IP consisting of 3 APs. In the broad focus condition, the default tonal pattern is thus expected to be $\{[\text{LHiLH*}]_S\ [\text{LHiLH*}]_V\ [\text{LHiLL\%}]_O\}$. When possible, we favoured sonorants in order to facilitate the F0 tracking. Below are the eight sentences used.

(1) [Jean]$_{S1}$ [veut ménager]$_{V4}$ [nos jolis nouveaux navets]$_{O7}$.
      'Jean wants to spare our fine new turnips.'
(2) [Romain]$_{S2}$ [ranima]$_{V3}$ [la jolie maman]$_{O5}$.
      'Romain revived the good-looking mother.'
(3) [Mélanie]$_{S3}$ [vit]$_{V1}$ [les mauvais loups malheureux]$_{O7}$.
      'Melanie saw the unhappy bad wolves.'
(4) [Véroniqua]$_{S4}$ [mangeait]$_{V2}$ [les mauvais melons]$_{O5}$.
      'Veroniqua was eating the bad melons.'
(5) [Les mauvais loups]$_{S4}$ [mangeront]$_{V3}$ [Jean]$_{O1}$.
      'The bad wolves will eat Jean.'
(6) [Mon mari]$_{S3}$ [veut ranimer]$_{V4}$ [Romain]$_{O2}$.
      'My husband wants to revive Romain.'
(7) [Les loups]$_{S2}$ [suivaient]$_{V2}$ [Marilou]$_{O3}$.
      'The wolves followed Marilou.'
(8) [Le beau marin]$_{S4}$ [vit]$_{V1}$ [Véroniqua]$_{O4}$.
      'The good-looking sailor saw Veroniqua.'

The corpus was recorded from a male native speaker of French. The speaker uttered the sentences in a sound attenuated room. Four conditions were elicited: subject-, verb- and object- focus and broad focus. In order to trigger focus, the speaker listened to a prompt in which the sentence to be pronounced was slightly modified. He then had to perform a correction task and thus focused the phrase which had been mispronounced in the prompt. An example of the recording procedure is given in (1) (capital letters signal focus):

(1)   *Speaker reads* : Les loups suivaient Marilou.
        Speaker hears : Les loups suivaient Aurélie ?
        Speaker says : Les loups suivaient MARILOU.

The speaker was given no indication on how to produce focus (e.g. which syllables should be accented). There were thus 64 utterances to study (8 sentences, 4 focus conditions, 2 repetitions). The productions were down-sampled at the rate of 16kHz. Syllable durations and the F0 parameter were measured using the PRAAT software ([15]). The autocorrelation method was used for the detection of F0.

4. Broad focused utterances

As explained in section 1.2.2, the default tonal pattern expected for the broad focused utterances was $\{[\text{LHiLH*}]_S$ $[\text{LHiLH*}]_V\ [\text{LHiL\%}]_O\}$, the Hi of the S and the V being optional as well as all the L tones. This pattern was indeed observed when the number of syllables of the object was larger than or equal to 5. However, when the number of syllables was smaller than 5, the verb and object were grouped into a single AP whatever the number of syllables in the verb. In this case the tonal pattern observed was $\{[\text{LHiLH*}]_S\ [\text{LHiL\%}]_{V+O}\}$. An example of this verb and object grouping is given in *Figure 2*.

The syllable bearing the H* AP boundary tone (resp. the L% (or H%) IP boundary tone) is the last syllable of the AP

(resp. IP) considered. As explained in [12], these boundary syllables are lengthened. For this speaker, we indeed measured a significant (ANOVA test: $F_{(1,34)} = 22.17$, $p < 0.001$) AP final lengthening of 31.5% which is perceptually relevant (larger than the "Just Noticeable Difference" of 20%: see [12]). We also measured an even more significant (ANOVA test: $F_{(1,14)} = 58.99$, $p < 0.001$) lengthening of the IP final syllable i.e. 36.3%.
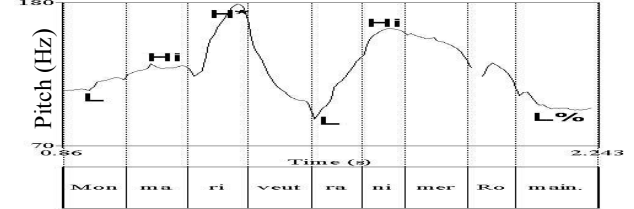

Figure 2: F0 trace for an IP including 2 APs in the broad focused case. The utterance was $\{[\text{Mon mari}]_{AP}$ $[\text{veut ranimer Romain}]_{AP}\}_{IP}$ ('My husband wants to revive Romain.').

5. Focus realization

5.1. Focal constituent

Pitch: In [5], it was claimed that the focal Hf tone most often replaced the Hi tone with a deletion of the H* tone. Table 1 shows the percentages of Hf tones replacing either Hi, either H*, either both or Hi with the presence of a residue of H*. We can see that, for this speaker, Hf most often replaces:
-   For the subject focus case: either both Hi and H* (Hi&H* in Table 1);
-   For the verb focus case: Hi with a great probability for having a residue of H*;
-   For the object focus case: Hi (recall that there is no H* on the object in the broad focused case).

Table 1: Frequency of locus of the Hf tone (in % of the total Hf tones) for the subject (SF), verb (VF) and object (OF) focus conditions.

	SF	VF	OF
Hi	13.3	6.7	100
H*	26.7	33.3	
Hi&H*	40	13.3	
Hi + H* residue	20	53.3	

The F0 values of the Hi (or H*) tones in the broad focused case were compared to that of the corresponding Hf tones in the focused condition. It was found that under focus the F0 value of a tone was risen by 20% (significant: ANOVA test: $F_{(1,78)} = 50.39$, $p < 0.001$).

Duration: The mean duration of the focused syllables was measured and compared to that of the same syllables in the unfocused versions of the utterances. The mean duration of the focal syllables was significantly higher (epsilon test, $p < 0.01$). The mean lengthening from the broad focus case to the focus case is of 33.71% which is perceptually relevant.

The duration of the first phoneme of the focused phrase was also measured and compared to that of the same first

segment of the same phrase in the unfocused version of the utterance. It showed that the first segment was significantly lengthened (epsilon test, p < 0.01) when the phrase it belongs to was focused. The mean lengthening measured was of 59%. The first segment is therefore more lengthened than the rest of the focused phrase (only 33.71%).

5.2. Pre-focal sequence

Pitch: For 59% of the stimuli having a pre-focal subject (i.e. the verb and object focused utterances), the tonal pattern of this prefocal subject was the same as that of the same subject in the broad focused case. However, the tones were downstepped by 17.3% for Hi (difference significant for both the verb and object focus cases at p = 0.01: ANOVA test $F_{(2,15)}$ = 25.62, p < 0.001) and 17.3% for H*(difference significant for both the verb and object focus cases at p = 0.01: ANOVA test $F_{(2,27)}$ = 20.19, p < 0.001).

For 28% of the stimuli having a pre-focal subject, the Hi tone was deleted and the H* tone was downstepped by 18.3% as in *Figure 3.b* in which the LHiH* tonal sequence of the subject in the broad focused case (see *Figure 3*) is replaced by a LH* tonal sequence in the verb focused case.
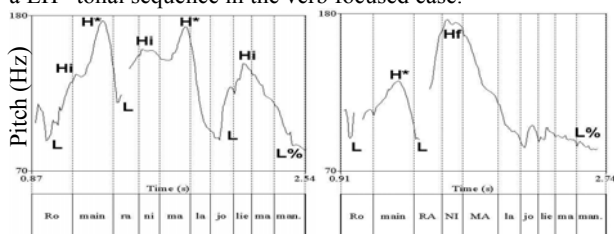

Figure 3: F0 trace for an IP including 3 APs. a. (left) broad focused case. b. (right) contrastive focus on the verb AP. The utterance was {[Romain]$_{AP}$[ranima]$_{AP}$[la jolie maman]$_{AP}$}$_{IP}$ ('Romain revived the good-looking mother.').

Duration: We compared the duration of the syllable directly preceding the focused constituent to the one of the same syllable in the broad focused case. We found a lengthening of 20% of the pre-focal syllable. This lengthening should be perceived by listeners since it corresponds to the "Just Noticeable Difference" of 20% (see [12] p.57) should therefore be considered as an important acoustic correlate of contrastive focus in French.

We compared the mean duration of all the prefocal syllables with that of the same syllables in the broad focused case. We found a significant pre-focal lengthening of 6% (ANOVA test: $F_{(1,62)}$ = 8.24, p= 0.006) which is much smaller than the "Just Noticeable Difference". This enables us to assume that the only pre-focal syllable noticeably lengthened was the one directly preceding the focal constituent. This phenomenon probably corresponds to an anticipatory strategy by the speaker. The origin of this lengthening or slowing down might be an articulatory anticipation as explained in [16].

Pre-focal rephrasing: It was explained in section 4 that in the broad focused case when the number of syllables of the object was smaller than 5, the verb and the object were grouped in a single AP. The question here is: what happens to the verb when the object is focused? In 62.5% of the cases,

the verb and object are separated into two APs. Indeed, an H* appears on the verb and the duration of the final syllable of the verb is lengthened by 30.6% compared to the same syllable in the broad focused case: this corresponds to the AP final lengthening (a correlate of the H* tone). An example of this phenomenon is given in *Figure 4*. This figure corresponds to the object focus version of the utterance shown in *Figure 2*.
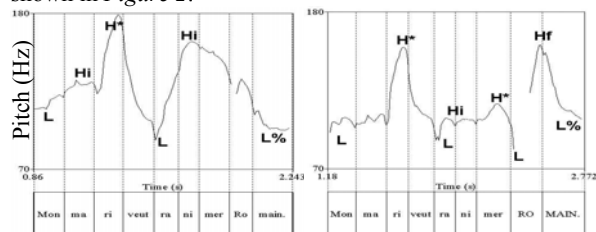

Figure 4: F0 trace for an IP including a. (left) 2 APs in the broad focused case and b. (right) 3 APs in the object focus case. The utterance was {[Mon mari]$_{AP}$ [veut ranimer]$_{AP}$[Romain.]$_{AP}$ }$_{IP}$ ('My husband wants to revive Romain.').
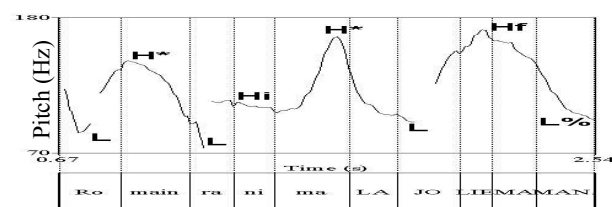

Figure 5: F0 trace for an utterance including 1 IP in the broad focused case and rephrased into 2 IPs in the object focused case. The utterance was {[Romain]$_{AP}$ [ranima]$_{AP}$}$_{IP}$ { [LA JOLIE MAMAN.]$_{AP}$}$_{IP}$ ('Romain revived the good-looking mother.').

In section 4, it was also explained that when the number of syllables of the object was larger than or equal to 5, the verb and the object were separated into two APs. We noticed that when these sentences were object focused, the S and V were grouped into an IP (consisting of two APs) separate from another IP consisting of the object. Indeed, we observed that the H* boundary tone of the verb AP in the broad focused case was highly upstepped when the object was focused. Moreover, in the object focus case the H* tone of the verb was 13,7% higher than the H* tone of the subject. This is not consistent with the global declination of F0 throughout an utterance. The last syllable of the verb was also lengthened by 26.3% compared to the broad focused case. This lengthening associated with the upstepping of the H* tone allowed us to interpret this H* tone as a high IP boundary tone (H%). This tone signals the end of an IP and a continuation of the utterance (continuation rise). An example of this rephrasing is given in *Figure 5*.

5.3. Post-focal sequence

Pitch: In this corpus and for this speaker, the focal constituent is always followed by a low pitch plateau such as the one on the object in *Figure 4.b* which corresponds to a verb focus case. The L tonal target is generally reached either on the first or the second post-focal syllable. The post-focal

sequence is thus deaccented as is the object in *Figure 3.b*. The F0 of the low plateau is of 87.9Hz in average which is not significantly different from the L% tone level of the broad focused utterances.

Duration: We measured the mean duration of the post-focal syllables and compared it with the mean duration of the same syllables in the unfocused condition. We found that the verb and object post-focal sequences were neither significantly shortened nor lengthened after a focused phrase. The null hypothesis of equality of the mean durations of the syllables of the post-focal sequences and the same sequences in unfocused utterances cannot be rejected (ANOVA test: $F(1,50) = 0.05$, $p = 0.82$). This allows us to suggest that the post-focal sequence is durationally identical in the focused and broad focused conditions. Moreover, we also compared the durations of the last syllables of each subject and object focused utterance to the duration of the same syllable in the broad focused case. The aim was to check whether the IP final lengthening was still present (no reduction of the duration of the last syllable of the IP). The null hypothesis of equality of the mean durations of the IP final post-focal syllables and of the same syllable in the broad focused case cannot be rejected (ANOVA test: $F(2,45) = 0.11$, $p = 0.9$). It can therefore be assumed that the post-focal sequence is deaccentuated without being dephrased. The phrasing information in post-focal sequences is still born by durational cues such as the IP final lengthening as reported in other studies ([3, 5]).

6. Conclusion

This paper aimed at precisely describing the acoustic correlates of contrastive focus in French. Some of the correlates measured here had already been identified by other authors. However, this paper also puts forward a number of newly observed correlates. The pre-focal, focal and post-focal constituents were analyzed separately. The following acoustic correlates of contrastive focus in French were found:

-   **Focal constituent:** the pitch was 20% higher than for the broad focused case. Moreover, the focal syllables were lengthened by 33.71% and the onset segment was lengthened by 59%.
-   **Pre-focal constituent:** It was found that the pre-focal syllable (the one preceding the focal constituent) was lengthened by 20%. Moreover, pitch was lowered by about 20% before focus (compared to the pitch of the same constituent in the broad focused case). Finally, in the object focus case, the utterance was rephrased. When the verb and object were grouped into a single accentual phrase (AP) in the broad focused case, the verb was isolated in a new AP when the object was focused. When the verb and object were separated into 2 APs in the broad focused case, the subject and verb were isolated into a different IP than that of the object in the object focus case.
-   **Post-focal constituent:** deaccented but not dephrased.

Therefore, when a constituent is focused, its pitch rises and that of the surrounding constituents decreases marking a large difference between the pitch of the focal constituent and that of the other constituents. Moreover, the duration of the focal syllables and of the pre-focal syllable increase. The lengthening of the onset of the focal constituent is the most significant. The pre-focal sequence is rephrased and the post-focal sequence is deaccented.

These results will have to be confirmed for other speakers.

8. References

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