Embedded register levels and prosodic phrasing in French

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Abstract

Within the autosegmental-metrical theory of intonation [1,2], there is only weak evidence for the existence of the intermediate phrase (ip) for French. Our proposal is that the emergence of an intermediate prosodic level is not merely linked to a specific focus or marked syntactic structure, while predicting that an alignment constraint (ALING-XP,R; ip,R) conspires to place an ip boundary at the right edge of a maximal projection, such as at an NP/VP boundary, when the maximal projection can be parsed into at least two accentual phrases. Alos, an ip boundary appears to be signaled by prosodic cues that are stronger than the ones associated to (ip-internal) AP boundaries. The alignment between major syntactic constituents and prosodic structure appears to be signaled by a H- tone aligned at the right edge of the ip (blocking recursive downstep of ip-internal LH* rises) as well as preboundary lengthening. Finally, partial reset of the first LH* following the ip boundary is taken as evidence for an internal structuring of the Intonation Phrase.

Index Terms: intermediate phrase, prosodic phrasing, preboundary lengthening, downstep, pitch reset, embedded register levels, French.

1. Introduction

Current studies on French intonation agree on the existence of at least two prosodic units, though differently defined and labeled depending on approaches and authors. In Jun and Fougeron's model [3,4,5], casted within the framework of the autosegmental-metrical theory of intonation, the smallest prosodic phrase is the accentual phrase or AP, which is the domain of primary stress and is characterized by an obligatory final rise (LH*), preboundary lengthening and an optional initial rise (LHi). The association properties of the initial rise were later studied by Welby [6]. The early rise (LHi) and the late rise (LH*) respectively demarcate the initial and final boundaries of the AP. APs can be grouped into intonation phrases (IPs), which are marked at their right edge by either a L% or a H% boundary tone. In Post’s model [7], the lowest level of the prosodic hierarchy is the phonological phrase (PP), a rhythmic constituent which is build on the basis of prosodic phonological rules. Finally, in contrast with Jun & Fougeron and Post, Di Cristo and Hirst’s model [8,9,10,11], assume three basic units: the tonal unit (TU), the rhythmic unit (RU) and the intonation unit (IU). The TU, which is the smallest prosodic unit in this model, is delimited by a L and H tone. On the other hand, RUs, which are not tonally defined, account for the primary stress description.

In the intonational phonology literature, the existence of an intermediate level of phrasing has been shown for several stress-accent languages such as English [12], Italian [13,14], Catalan [15] and Cairene Arabic [16]. In Di Cristo and Hirst’s model an intermediate level of phrasing (i.e., the intonation phrase segment, S.UI) has been proposed in order to describe the behavior of specific syntactic structures such as tag-questions, dislocations or postpositions [10]. Similarly, Jun and Fougeron [5] have proposed the existence of the intermediate phrase to account for specific intonation structures observed in marked syntactic constructions, such left-dislocated sentences, in which either a low or a mid plateau is found after a LH* rise. These plateaux would be the result of the presence of either a L- or a H- phrase accent controlling the pitch range until the right edge of the Intonation Phrase.

In stress-accent languages such as English and Italian, the ip is the domain of downstep and is delimited at its right edge by a phrase accent. Moreover, pitch register is reset after an ip boundary (hence ip-internal, recursive downstep is blocked). In French, Post [7] has suggested that subsequent H* tones can be downstepped within the larger domain of the intonation phrase, while no reference to rule-governed downstep is made in the work on French made by Jun and Fougeron. Thus there seems to be some evidence supporting the existence of an intermediate level of phrasing in French even if its status is still controversial.

Within the framework of Generalized Alignment Theory [17], the role of alignment constraints on the placement of prosodic boundaries has been shown for various languages [18,19,20,21,22]. In this study we predict that ip boundaries would not be restricted to marked constructions but might appear within all-focus sentences if both the syntactic and the prosodic structure allow it. Specifically we predict that an alignment constraint (ALIGN-XP,R; ip,R) conspires to place an ip boundary in correspondence with a major syntactic break, such as the boundary between a subject noun phrase (NP) and a verb phrase (VP). We also predict that in a sentence such as *La mamie de Rémy demandait l’institutrice* 'Remy's grandmother asked for the teacher', an ip boundary would occur at the right edge of the word *Rémy* (see Figure 1). As a consequence, apart from the presence of a H- tone at the end of the Subject NP, we expect that the final syllable [mi] would be marked by stronger markers of disjuncture than the ones associated with an ip-internal AP boundary (cf. the syllable [mi] of amis in Figure 2).

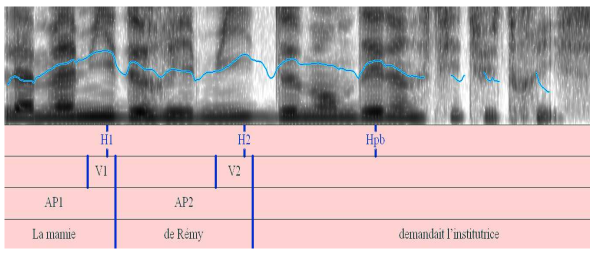

Figure 1: *F0 curve for the utterance La mamie de Rémy demandait l’institutrice ('Remy's grandmother asked for the teacher') where the subject NP is made of 2 APs.*

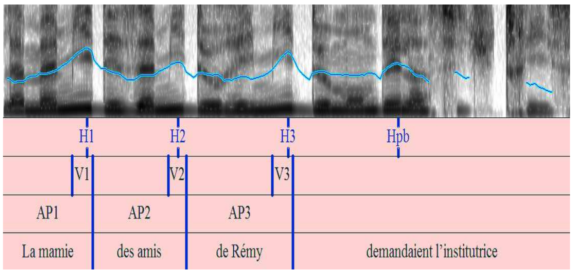

Figure 2: *F0 curve for the utterance La mamie des amis de Rémy demandait l'institutrice ('The grandmother of Remy's friends asked for the teacher') where the subject NP is made of 3 APs.*

2. Method

2.1. Corpus

We investigated the properties of 8 all-focus SVO utterances in which the structure of the subject NP was varied in order to obtain a sequence of either 2 or of 3 APs, as shown in (1) and (2):

(1) *La mamie]*$_{AP}$ *de **Rémy**]*$_{AP/ip}$ *demandait l'institutrice]*$_{IP}$.
"Remy's grandmother asked for the teacher."

(2) *La mamie]*$_{AP}$ *des **amis**]*$_{AP}$ *de Rémy]*$_{AP/ip}$ *demandait l'institutrice]*$_{IP}$.

"The grandmother of Remy's friends asked for the teacher."

Target syllables (in bold above and underlined in Figure 2) were all CV. Target vowels (in bold and underlined in figure 2) were either the high vowel /i/ or the low vowel /a/. In order to facilitate the F0 analysis, the preceding consonant was always a voiced nasal (/m/ or /n/) or the liquid /ʁ/. The following consonant was always /d/. The NP condition (2 APs vs. 3 APs) was crossed with vowel height (high/low). Items are shown in Table 1.

		Subject NP made of 2 APs
Type of vowel	high	La mam**ie**]AP de Ré**my**]ip demandait l'institutrice.]IP
	high	Le ma**ri**]AP de Ca**rry**]ip deviendra un grand docteur.]IP
	low	Le sau**na**]AP d'Hélé**na**]ip deviendra le plus connu.]IP
	low	Le trois-**mâts**]AP de Tho**mas**]ip devance tous les autres bateaux.]IP
		Subject NP made of 3 APs
Type of vowel	high	La ma**mie**]AP des a**mis**]AP de Ré**my**]AP demandait l'institutrice.]IP
	high	Les car**rie**s]AP du ma**ri**]AP de Car**ry**]ip demandaient des soins urgents.]IP
	low	La na**na**]AP du sau**na**]AP d'Hélé**na**]ip devenait vraiment méchante.]IP
	low	Le sché**ma**]AP du trois-**mâts**]AP de Tho**mas**]ip devenait vraiment brouillon.]IP

Table 1: *Corpus items.*

2.2. Procedure

Two French native female speakers read the sentences four times at both normal and fast speech rate, since rate has been shown to affect phrasing in a significant way [23,24], yielding a total of 128 experimental sentences (8 sentences x 2 speech rates x 4 repetitions x 2 speakers), plus 16 filler items. The sentences, which were block randomized, were visually presented on a computer screen. Participants were instructed to press the space bar on the keyboard to retrieve the next sentence. Speakers were recorded through professional equipment at 44.1 kHz onto digital audio tape (DAT), using a Shure SM10A head-mounted microphone in a soundproof room at the Laboratoire Parole et Langage of the University of Provence.

Before the experiment began, participants read six sentences in order to test the material and become familiar with the procedure, at both normal and fast speech rate. Each utterance was saved as a separate file. Acoustic segmentation, F0 extraction and tonal target detection were performed using Praat [25].

2.3. Hypothesis

We predicted that ip right boundary cues would be stronger than those associated to (ip-internal) AP right boundaries. We hence examined both duration and F0 values at normal and fast speech rates. First, we focused on the vowel associated to the second LH* of the utterances (H2 on V2). We hence compared the duration and F0 height of V2 in the 2-AP condition with the duration and F0 height of V2 in the 3-AP condition.

Our first hypothesis was that at both normal and fast speech rate V2 would be longer in the 2-APs condition than in the 3-APs. We also predicted that H2 would be higher in the 2-APs condition than in the 3-APs condition because ip-internal downstep of subsequent LH* would only be blocked at ip-final position (i.e. at the NP/VP boundary).

Then we focused on the F0 height of the first LH* of the following ip (postboundary H, or Hpb, on *demandait* in Figure 1 above) for both 2 and 3-AP conditions. Generally, after a prosodic boundary, pitch register can be totally reset [12]. However, partial reset has already been observed in Germanic languages such as English [26], Dutch [27] and German [28]. Here we predicted that Hpb would be partially reset, hence that it would be lower than the H- edge tone associated to a preceding ip-boundary (H2 in the 2-AP condition or H3 in the 3-AP condition), due to register level downstep within an non-initial ip.

2.4. Measures

The duration of each of the vowels within the target syllables (V1, V2 and V3 in Figure 1) as well as their maximum F0 value (H1, H2 and H3) were measured. We also measured the height of the first LH* within the following ip (e.g. within *demandait* in Figure 1 above), or Hpb (postboundary H).

H2 and H3 target values were measured as a ratio of the first target peak (H1). This measure was intended to normalize the range variability found both within and across speakers, and allowed us to better evaluate register effects. Likewise, the degree of lengthening for the target vowel was measured as a ratio of the duration of first target vowel, so that rate variability could be further controlled.

We also measured the total duration of the utterance in order to verify that the rate manipulation was significant, which was the case [$F(3,124) = 0.68297$, $p < 0.001$]. Average speaking rate in syllables/second was also calculated for each speaker.

3. Results

First, we verified that successive lowering of LH* peaks within the ip would be blocked at the right edge of the ip itself. In other words, we predicted that the H target for LH* would be higher in [mi] of *Remy* in Figure 1 (which is both AP and ip-final) than in the [mi] of *mamie* in Figure 2 (which is only AP-final).

The results for H2 F0 height are shown in Figure 3. Here we show values for both speakers, expressed as a ratio of H1 F0 height, for 2-APs and 3-APs utterances. Results are separately shown by speech rate. In line with our assumptions, H2 was significantly higher in NP subject phrases uttered as two APs than in NPs uttered as 3 APs, independent of speech rate, although this difference was more marked for fast than for normal speech rate. This supports the assumption that if a successive lowering of non-initial H tones is observed within the ip, this lowering is blocked at the right edge of the same ip.

Figure 4 shows lengthening of V2 relative to V1 for both AP number conditions and the two speech rates. Note that, as predicted, V2 lengthens relative to V1 only when the vowel belongs to the last syllable of 2-APs NPs (i.e. when it was at the right edge of the ip), while it did not lengthen when ip internal (when followed by another AP, as in the 3-APs condition). Note also that at fast speech rate the degree of lengthening is smaller.

Two mixed models [29] were conducted separately for vowel lengthening of V2 relative to V1 and F0 height ratio between H2 and H1. Both models had rate (normal vs. fast), NP type (2APs vs. 3APs), vowel type (/i/ vs /a/) and speaker (CD vs. CP) as fixed effects and preceding consonant as random effect.

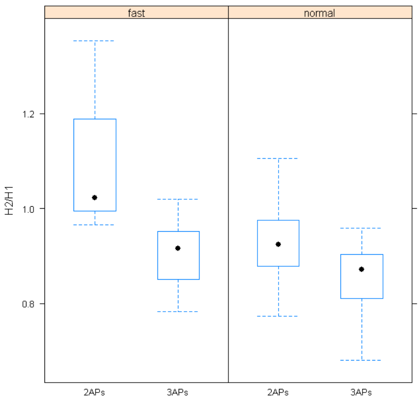

Figure 3: *F0 height ratio between H2 and H1 in 2-AP and 3-AP utterances at fast (left) and normal (right) speech rates.*

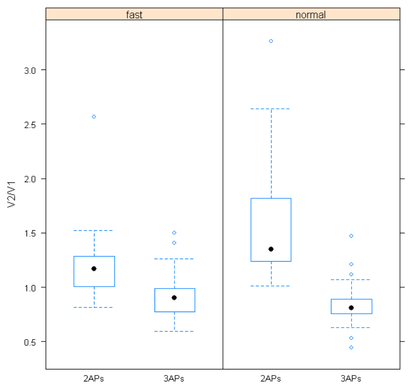

Figure 4: *Vowel lengthening of V2 relative to V1 in 2-AP and 3-AP conditions at fast (left) and normal (right) speech rates.*

In line with our hypothesis, at both speech rates the mixed models showed that H2 was significantly higher in the 2-AP condition than in the 3-AP condition (normal speech rate: *t=-3.67, p<0.05*; fast speech rate: *t=-9.43, p<0.05*). Moreover, V2 was significantly longer in the 2-APs condition than in the 3-APs condition (normal speech rate *t=-8.487, p<0.05*; fast speech rate *t=-3.250, p<0.05*).

We then focused on the values of the first LH* peak after the intermediate phrase boundary (Hpb). Figure 5 shows ratios of the F0 value for either H- (the last H target before an ip boundary) or Hpb, relative to H1, at fast and normal rate. Note that Hpb was always lower than H-, hence downstepped relative to the register level of the first ip.

A mixed model was conducted for F0 height ratio between H- and H1, Hpb and H1 with rate (normal vs. fast), tone type (H- vs. Hpb), vowel type (/i/ vs. /a/) and speaker (CD vs. CP) as fixed effects and preceding consonant as random effect. As expected, for both speech rates, Hpb was significantly lower than H- (for normal speech rate: *t=-5,26, p<0.05*; for fast speech rate: *t=-9.30, p<0.001*).

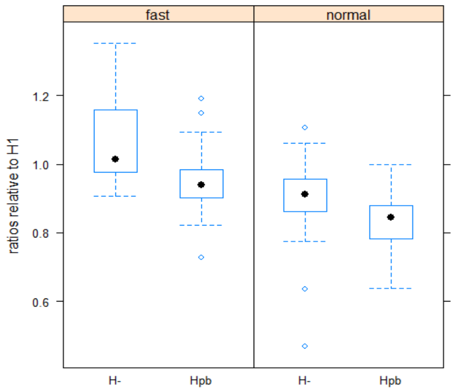

Figure 5: *F0 height ratios for H- and Hpb relative to H1 for both normal and fast speech rates.*

4. Discussion

Our results showed an interesting structuring of subsequent LH* rises within complex NPs and confirmed our main hypothesis. Specifically, the target syllables were produced with significantly higher F0 values when associated with an ip-boundary (i.e. in 2-APs utterances) than when ip-internal. Moreover, greater lengthening of the vowel nucleus was also found for ip-final syllables as compared to non-final ones. Also note that both effects were found at both fast and normal speech rates, though the F0 difference was more marked for fast utterances, in which proportionally higher ip-final rises were found. These results, in line with recent studies on prosodic phrasing in French [24,30], suggest that the presence of an ip boundary might not be restricted to marked constructions as was previously proposed [4,10].

We hence propose that an ip-boundary might appear within all focus utterances if both the syntactic structure and the prosodic structure allow it. We specifically claim that an alignment constraint of the type (ALIGN-XP,R; ip,R), i.e. “align the right edge of a syntactic XP with the right edge of an intermediate phrase”, conspires to place an ip boundary at the right edge of a major syntactic constituent when it can be phrased as at least two APs. We also propose that the right boundary of a non-final ip is signalled in French through a rising contour due to the presence of an H- phrase accent, which is aligned with the last vowel of the phrase. Different from [5], we propose that the H- tone does not need to spread to the right, but can also be instantiated as simple peak target. The H- tone seems responsible for blocking the iterative downstep of the subsequent LH* within the initial ip, supporting the hypothesis of a return to the register level (total pitch reset) set by the first LH* F0 peak of the intonation phrase.

Moreover, our results appear to support the hypothesis of partial reset after an ip boundary in French as it is the case for several languages such as German [21]. The first LH* of the second ip (Hpb) was in fact raised relative to the downstepped value of H2 in 3-APs utterances, yet lower than H1 (since Hpb ratios were always below 1). The relative level of each H target in 3 APs utterances is schematized in Figure 6.

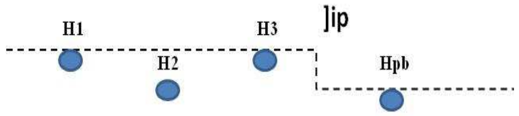

Figure 6: *Register downstep for sentences in which the subject NP was uttered as 3 APs.*

Therefore, we propose that an ip boundary, apart from being characterized by a return to the register level set by the first LH* peak of the phrase, is also characterized by partial pitch reset after the boundary itself. This is line with recent studies which support the idea of embedded register downstep, i.e. downstep among accents can be embedded inside downstep among larger prosodic domains [26,27,28,30]. Note also that the height of the H- target is never higher than H1, which sets it apart from H% whose target is generally the highest within the IP (see also [7]).

Finally, our results also suggest that, at fast speech rate, downstep within and across the ip is reinforced whereas duration cues are less marked than at normal speech rate. These results, in line with studies on duration cues and prosodic boundaries in French [24] seem to support the idea of a complex marking of prosodic boundaries, and therefore of the interplay of different phonetic and phonological cues.

5. Conclusion

In this study we show that, in French, a syntax/prosody alignment constraint might be responsible for placing an ip boundary at the right edge of a major syntactic boundary in prosodically complex NP subjects, i.e. made of at least 2 APs. We also show that the right boundary of the ip is signaled by preboundary lengthening as well as by the presence of a H- phrase accent, which would be responsible for blocking recursive downstep of subsequent AP final rises within the ip. We also found partial reset across the ip boundary reflecting an internal structuring of the Intonation Phrase and supporting the hypothesis of register level downstep. This is taken as evidence that, at least in French, prosodic boundaries need to be defined relative to both local and global cues.

6. References

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