

## THE ACCENTUAL PHRASE AND THE PROSODIC STRUCTURE OF FRENCH

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### ABSTRACT

A model of French intonational phonology is proposed based on pitch tracks of three Parisian speakers' read utterances. The lowest prosodic level defined based on tone is an Accentual phrase and has a LHLH pattern. This model is compared with the models of previous proposals.

### INTRODUCTION

French intonation has long been known to have a sequence of rising pitch movements. Most studies so far have been phonetic and acoustic descriptions of French intonation. Phonological descriptions of French intonation have recently been proposed, among others, by Hirst and Di Cristo (H&DC) [2] [3], Mertens [5], and Post [8]. They agree that a tone is associated with a stressed syllable and stress is rhythmic or postlexical. They also agree that an utterance is hierarchically organized with different prosodic levels, but they disagree in the levels below the intonational phrase (IP) and their tonal representation.

H&DC propose two levels below IP: a Rhythmic Unit "governing" a Tone Unit, while Mertens proposes an Intonation Group "governing" a Stress Group. These prosodic units are delimited by a prominence-lending syllable (or stressed syllable). On the other hand, based on the syntactic structure, Post proposes a Phonological Phrase as the domain of a pitch accent, which is a tonal property of a stressed syllable. The Tonal Unit, Stress Group, or a pitch accentable syllable are all based on stress including the secondary (or initial) stress, and the Rhythmic Group and Intonation Group are delimited by the primary (or final) stress.

In this paper, we examine the tonal variation related to secondary and primary stress, their domains, and syllable-tone association. We propose that the lowest prosodic level defined by tone in French is the Accentual Phrase

(AP) [1]. The AP, which can encompass more than one word, is the domain of the primary and the secondary pitch accent, and has a tonal pattern of LHLH. We call this prosodic unit an AP because, as in Japanese [7] and Korean [4], the AP-final rise in French is a delimitative tone. By assuming the underlying four tones associated with certain syllables within an AP and phonetic implementation rules [1,7], we can capture the relation between the secondary and primary pitch accents, and explain various realizations of French phrasal intonation.

### METHOD

Pitch tracks of utterances read by three Parisian French speakers (1 male, 2 female) were analyzed using XWAVES. 59 sentences with different syntactic structures were repeated four times in random order. In these sentences, there were three major syntactic categories, Subject NP, VP and PP. Within each category, the number of syllables and the number and position of words were varied. Examples (selected):

"Marie mangera des bananes"  
(Mary-will eat-some-bananas)  
"Marie-Anna mangera des bananes"  
(Marianna-will eat-some-bananas)  
"le mauvais garçon ment à sa mère"  
(The-bad-boy-lie-to-his-mother)  
"le garçon malade ment à sa mère"  
(The-boy-sick-lie-to-his-mother)  
"Marion mangera au dîner des bananes"  
(Marion-will eat-for-dinner-some-bananas)  
"Marion mangera des bananes au déjeuner"

(Marion-will eat-some-bananas-for-lunch)

In addition, 46 test words were embedded in a carrier sentence, "X est un mot utilisé par les français" (X is a word used by French people). We put the word in sentence initial position, where the secondary (initial) stress is more likely to be realized [6]. The number of syllables of the words were varied from two to eight syllables: e.g.

médite, méditer, méditation,  
méditerranée, méditerranéen,  
méditerranéiser, méditerranéisation.  
Each sentence was repeated 4 times by each speaker.

### RESULTS

#### 1. Justification of AP as one group /LHLH/, not two /LH/s

As shown in Fig. 1(a), one long word is realized as two rising movements: the first rising around the secondary (initial) stressed syllable and the second rising at the primary (final) stressed syllable. In Fig. 1(b), two words show two similar rising movements: the first around the secondary stressed syllable of the first word and the second at the primary stressed syllable of the second word.

The sequence of rising patterns (LH) as shown in Fig. 1(a, b) has been analyzed as two groups, e.g. Tonal Units or Stress Group. But we found that these two patterns are closely related with each other. They look similar regarding the timing of the two rising movements: the initial and final rising each takes about 200-300 ms regardless of the number of syllables in each rising part. But when we look at the falling movement, as shown in Fig. 2, we see that the falling timing from the first peak to the beginning of the second rise increases as the number of syllables increases between the two points. Thus, we propose that the two tones, (initial) H and (the following) L, are target tones within one AP, and the interpolation between these two tones covers the pitch realization of the intermediate syllables. More important, if we compare this falling time within one AP with the falling time between the AP-final-H and the following AP-initial-L (Fig. 3), we can see that the falling timing across APs does not depend on the number of syllable of the following AP, but is rather constant, about 100-200 ms.






Thus, if we consider a sequence of LH as a separate tonal unit, we cannot explain why the timing between two tonal units, LHLH, is highly correlated with the number of syllables in the second tonal unit, and why it is not the same across all LH tonal units. We need to distinguish the different fallings, and group the connected tonal units into the same group: /LHLH/AP /LH...

#### 2. Tone association with a syllable

The AP initial L and final H are realized in the first and the last syllable of AP, respectively. The L preceding the final H is associated with the penultimate syllable of an AP. For APs shorter than 3 syllables, this L tone is often realized on the final syllable. The initial H shows a variation in its realization on a syllable; the first to third syllable of the first lexical word. It may be "loosely" associated with the second syllable of the lexical word and realized earlier or later. Variation in the realization of the initial H, i.e. the initial stress, has been a big question in French, and, as shown by Padeloup [6], various factors such as phonotactic, rhythmical, contextual constraints may account for this variability.

#### 3. Realization of AP

We observed five patterns of AP shown below. The frequency of each pattern out of 466 tokens (Subject NP position only) is indicated in parenthesis.

	a. [LHLH] (36%)
	b. [(L)HLH] (25%)
	c. [L(H)LH] (26%)
	d. [LHL(H)] (1%)
	e. [LHL] (10%)

a. [LHLH]: all underlying tones are realized; the most common pattern, especially in phrases longer than 4 syllables.

b. [LH]: undershoot of medial HL; common in one or two syllable phrases.

c. [LLH]: initial peak is not realized by phonetic undershoot, or for intentional or pragmatic reasons.

d. [LHH]: undershoot of L between two Highs; when a short phrase has both initial and final accent.

e. [LHL]: (i) when the AP has an initial H (initial stress) and the following AP also has an initial H. (ii) when the AP is in the IP final position.

The four patterns (a-d) can be explained by phonetic rules like undershoot, while the realization of the last pattern (e) depends on the tonal

context and the prosodic hierarchy. To explain the last pattern, we propose a constraint to avoid three H tones. (\*HHH : a sequence of three H tones are maximally avoided). A sequence of two H tones are also often avoided (\*HH), explaining the low frequency of type 'd' AP.

In addition, when the AP is in the IP final position, we assume that the AP's H boundary tone is preempted by a higher level (IP)'s boundary tone. Thus, when the IP boundary tone is L%, AP is realized as [LHLL].

## DISCUSSION

Our model differs from H&DC's model in that we assume our AP (two of their Tonal Units) as the lowest prosodic level defined by a tone, and we consider Word as a part of prosodic hierarchy. H&DC's Tonal Unit boundary does not necessarily match the word boundary, violating the Strict Layer Hypothesis [9]. Their phrasing is more tone-driven, thus their model is closer to the surface representation

Our model is similar to Mertens' model in that both models assume that the lowest prosodic unit based on tone, i.e. our AP and his Intonation Group (IG), includes both the primary and the secondary pitch accent. But our AP differs from his IG (=((NA)AI) (NA) AF (NA)) in that we assume four underlying tones while he assumes only one underlying tone, AF, and an optional tone after the final stressed syllable. In addition, he assumes each tone can be L or H with four levels of height. Thus, his representation is much closer to the phonetic representation.

Our AP also differs from Post's Phonological Phrase (PP) in the way the prosodic unit is defined. His PP is defined based on a syntactic structure. Our AP formation is constrained by, but not predictable from, syntactic structure. But, as well known, a tonal unit does not always match a syntactic structure. Our AP also differs from his PP in that we allow no APs without pitch accent and we allow only H toned pitch accents.

By assuming an Accentual Phrase with an LHLH underlying tonal pattern, tone interpolation, and phonetic undershoot, we can explain and predict various tonal contours of one AP, the

slope from the initial peak (H) to the following L, and the same tonal pattern of a long one word AP and that of AP having more than one word.

Next, we can also compare French AP patterns and its realization with those of other languages such as Japanese and Korean. The Japanese AP has at most one pitch accent, which is linked with the underlying pitch-accented syllable, while French AP has two pitch accents, which are linked with the postlexically stressed syllables. On the other hand, Korean (Standard dialect) AP (LHLH) has no pitch accent, but only has phrasal tones which are linked to a certain position within the AP [4]. As in French, the falling timing (LHLH) in the Korean AP is correlated with the number of syllables within an AP.

## CONCLUSION

We propose that, in the intonational phonology of French, the Accentual Phrase has the tonal pattern of LHLH and it is the lowest prosodic level that is tonally defined. The AP includes both the initial and the final pitch accented syllable, and thus has at most two peaks. When an AP includes more than one word, the initial pitch accent is realized at the initial stressed syllable of the first lexical word and the final pitch accent is realized at the final stressed syllable of the last word within the AP. But due to undershoot and the tendency to avoid adjacent H, we observe five possible tonal realizations.

So far, we proposed two prosodic levels, AP and IP, in French. Further research is needed to find out if French has a prosodic level intermediate between AP and IP, i.e. an intermediate phrase (ip) as in Japanese and English.

Since this model is based on read speech in the laboratory setting, we plan to apply our model to utterances with different speech styles and to spontaneous speech.

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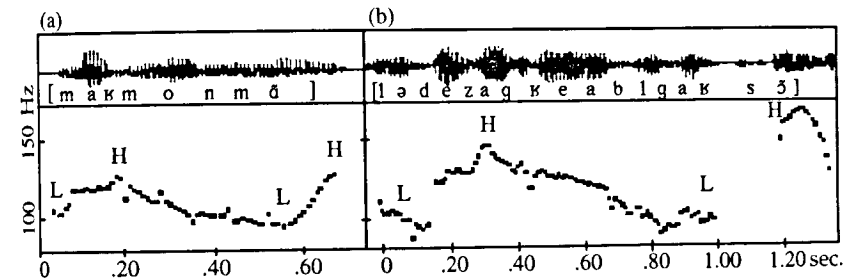


Figure 1. Pitch tracks of (a) One-word AP : "Marmonement est un mot utilisé par les français" and (b) Two-words AP : "Le désagréable garçon ment à sa mère", both produced by a Parisian-French male speaker (only the underlined part is shown).

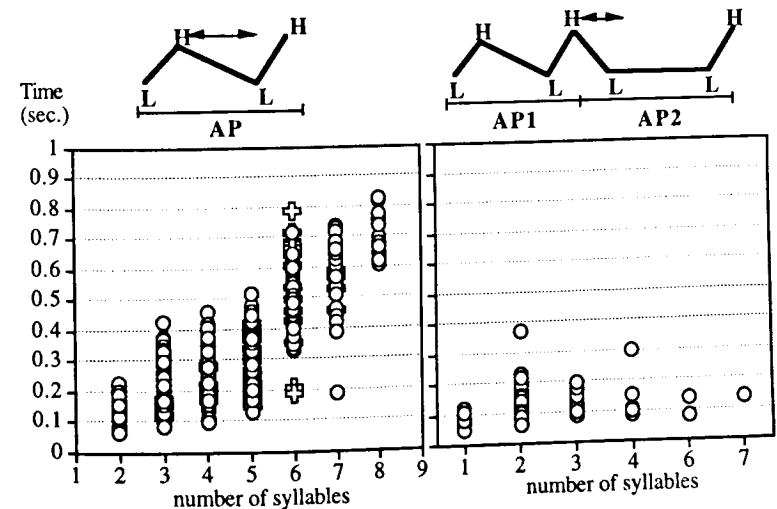


Figure 2. Falling timing within one AP, from the initial H to the following L, depending on the number of syllables in one-word APs (circles) and two-words APs (crosses).

Figure 3. Falling timing across APs, from AP-final H to the following AP-initial H, depending on the number of syllables in the second AP.