

Realizations of accentual phrase in French intonation

S.-A. JUN AND C. FOUGERON

Abstract

In this paper we provide a detailed account of the various realizations of the accentual phrase in our phonological model of French intonation (Jun & Fougeron 1995, 2000), and introduce a slight revision in tone-syllable association. In addition to the default and unmarked phrases, we examine the intonational contour of long polymorphemic words and utterances containing a sequence of several clitics. We discuss the status of additional H tones found in the marked phrases and the constraints on the distribution of these H tones.

1. Introduction

Unlike in other Romance languages such as Italian or Spanish, intonation in French is characterized by a sequence of rising pitch movements demarcating phrase boundaries. French also differs from other Romance languages in that stress does not have a distinctive function. The location of stress is fixed at the word level, but its realization depends upon the position of a word within a phrase (e.g., Grammont 1934, Delattre 1939, Martinet 1969). That is, the final full syllable of a word is realized with longer duration and higher intensity than non-final syllables only if it is the last full syllable of a *phrase*. In this case, the phrase-final syllable carries a primary stress, and is often realized with a rising pitch movement. For example, when the two-word phrase *un gentil garçon* ‘a nice boy’ occurs within the sentence *un gentil garçon chantait* ‘a nice boy was singing’, the primary stress falls on the last syllable of the second word (boldface). Therefore, in contrast with most other Romance languages, the domain of stress in French has changed over the course of its evolution from Latin from a lexical domain to a phrasal domain.

Traditionally, due to its phrase-final location, primary stress has been viewed as having a close connection ('syncretism') with intonation and has been treated as a phrase accent or an accent with a syntactic nature (Grammont, 1934; Marouzeau, 1956; Garde, 1968; Rossi, 1979; Martin, 1982). Phrase final rising was labelled "continuation mineure" in Delattre (1966) and "Intonème continuatif Mineur" in Rossi (1985), and these tonal patterns were treated as intonative morphemes. The domain of phrase final rising or primary stress often corresponds to one word, but depending on many factors such as speech rate, the length of the phrase, or syntactic and semantic constraints (e.g., Lucci 1983; Padeloup 1990; Delais-Roussarie 1995; Fougeron and Jun 1998), not every word forms one phrase. For example, a phrase may contain more words in fast speech than in slow speech, and it may contain more words when each word is short. The domain of primary stress has been variously labelled by different researchers: for example, it is referred to as "groupe de force" by Passy (1929), "mot prosodique" by Vaissière (1974, 1992) or "syntagme prosodique" by Vaissière (1997), "arc accentuel" by Fonagy (1979), "mot phonologique" by Milner and Regnault (1987), "intonation group" by Mertens (1987, 1993), "mot rythmique" by Padeloup (1990), "rhythmic unit" by Di Cristo and Hirst (1993) (or "prosodic word" by Di Cristo 1999), "groupe rythmique" by Delais-Roussarie (1995), and "accentual phrase" by Jun and Fougeron (1995, 2000) (see Lacheret-Dujour and Beaugendre 1999 for a review).

In addition to the primary stress, a phrase in French has also been claimed to have an optional secondary or initial rising pitch movement, known as secondary or initial stress¹. The initial stress is primarily realized with a rising pitch movement, but unlike the primary stress, its phonetic correlates are less clear. It is sometimes realized with a larger intensity and longer duration than unstressed syllables, but the lengthening difference seems insignificant (Padeloup 1992; Jun and Fougeron 2000). Studies such as Rossi (1985) and Padeloup (1990) claim that the initial stress occurs on the 1st or the 2nd syllable of a word most of the time, even when the word does not end with the primary stress, and it is more frequent on the first syllable when the syllable begins with a consonant than when it begins with a vowel. But, it is also claimed that the initial stress can occur in non-initial syllables of a word; specifically, it can occur on the antepenultimate syllable when a word ends with primary

1. The status of this initial rising pitch movement has been greatly debated in the literature on French prosody. Here, for the sake of simplicity, we call it "initial stress". However, it is clear that, for several researchers including us, this "stress" is essentially a pitch event, therefore an accent. Furthermore, some researchers (e.g., Rossi) claim that there are several types of initial pitch movement that vary according to their functions and conditioning factors such as rhythmic, pragmatic or expressive constraints. Rossi (1985, 1999) defined three types of initial stress (called 'accent'): "rhythmic accent" (or ictus mélodique), "enonciative accent" (for example, de focalisation), and "emphatic accent".

stress (e.g., Garde 1968; Verluyten 1984; Padsdeloup 1990) and at morpheme boundaries when the word is polymorphemic (e.g., Padeloup 1992; Delais-Roussarie 1995).

According to Padeloup (1990), the distribution of initial stress is conditioned by several factors, including rhythmic constraints, such as the following: the phonetic nature of the word-initial segment, the number of syllables in the word, the number of unstressed syllables in the group (more than 4 consecutive unstressed syllables are not allowed), the position of the word in the sentence (initial stress is more frequent in sentence-initial position), and the morphological structure of a word. In a corpus of 400 utterances, Padeloup found that initial stress occurred on almost all 6–7 syllable words, and on about 30% of the 3–5 syllable words. Further, she claimed that the realization of initial stress varied across speakers.

In this paper, we will examine the realizations of primary stress and what has been called “initial stress” in Parisian French and expand the phonological model of French intonation proposed in Jun and Fougeron (1995, 2000). The organization of this paper is as follows. In Section 2 we briefly describe our previous model of French intonation and introduce some slight revisions in tone-syllable association, and in Section 3 we provide examples of the most common realizations of an Accentual Phrase. In section 4 we examine the pitch contours of long polymorphemic words and utterances with a sequences of several clitics, and we try to account for their intonation patterns, which include multiple H tones. Finally, in Section 5, we discuss the status of the H tones in French and the constraints on their distribution and conclude the paper by clarifying the new features of our model.

2. Jun and Fougeron’s model of French intonation: Revision in tone-syllable association

The model of French intonation proposed in Jun and Fougeron (1995, 2000) is a phonological model of intonation based on the autosegmental-metrical framework (e.g., Pierrehumbert 1980; Beckman and Pierrehumbert 1986; Pierrehumbert and Beckman 1988; Ladd 1996). Following this framework, it is assumed that an intonational tune is composed of a sequence of H and L phonological tones, and that each tone is associated with a metrically strong syllable or the boundary of a prosodic unit. The surface realizations of the phonological tones are determined by phonetic implementation rules, and syllables that are tonally unspecified get their surface F_0 values by interpolating between two adjacent tonal targets. Additionally, tonal targets may be undershot if there are not enough syllables to carry the tones. We also assume that an intonationally defined prosodic unit is hierarchically organized and obeys the Strict Layer

Hypothesis (Selkirk 1986; Nespor and Vogel 1986). That is, a prosodic unit of a given level of the hierarchy is composed of one or more units of the immediately lower prosodic unit, and each unit is exhaustively contained in the immediately higher prosodic unit. Under these assumptions, we proposed two intonational units in French, the Intonational Phrase and the Accentual Phrase, in Jun and Fougeron (1995).

The lowest intonationally marked prosodic constituent for French is the Accentual Phrase (henceforth AP). The AP contains one or more Content Words (Wc), optionally preceded by one or more Function Words (Wf), and is demarcated by the primary stress. That is, an AP is the domain of primary stress.² Though the number of syllables in one AP varies depending on word length and the syntactic/semantic structure of the phrase as well as factors such as speech rate and individual speakers (e.g., Fougeron and Jun 1998), an AP tends to contain an average of 2.3~2.6 words (or 1.2 content words), and 3.5–3.9 syllables (Jun and Fougeron 2000). This is similar in size to comparable prosodic units proposed by Fonagy (1979) and Pasdeloup (1990): Fonagy’s “arc accentuel” contains 3.36 syllables on average in spontaneous conversation, and Pasdeloup’s “mot rythmique” contains an average of 3 syllables with a maximum of 7–8.³

In the previous version of our model (Jun and Fougeron 1995, 2000), we proposed that an AP has an underlying tonal pattern /LHiLH*/ with Hi representing what has been called the secondary or initial stress and H* the primary or final stress. The tone-syllable association within the AP was modeled in such a way that the initial L was linked to the beginning of an AP, Hi was ‘loosely’ associated with the first syllable of the AP-initial content word, H* was linked to the end of an AP and realized on the phrase final full syllable, and the preceding L was linked to the syllable immediately preceding the H*-toned syllable.

However, since the location of the Hi tone (i.e., initial stress) is not limited to a certain syllable but is realized on some ‘initial’ (i.e., first or second, and rarely the third, see above) syllable of the AP-initial content word, the association of this tone to a specific syllable must be reconsidered. In addition, the

2. This applies to neutral utterances recorded in the laboratory. In spontaneous conversation, emphatic clitics or contrastively stressed function words can also form one AP by themselves or with other clitics, without including a content word. This is an example of *prosodic promotion* such as that described in Pierrehumbert (1993). For example, in English each syllable can be uttered with a pitch accent as in [al][lex][san][der]!, and in this case lexically unstressed syllables are prosodically promoted to have a pitch accent with a full vowel.

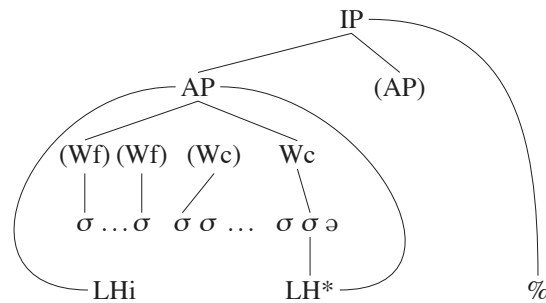
3. In contrast, Delais-Roussarie (1995) assumes a smaller average number of syllables in a comparable prosodic unit, which she called a “rhythmic group”; she claims that one rhythmic group contains a maximum of 7 syllables and prefers to have 2 syllables, but avoids having one syllable or more than 3 syllables.

relation between AP initial L and Hi appears to be closer than the previous tonal association can predict. Both can mark the initial boundary of an AP: i.e., an AP often begins with a L tone, but it can also begin with a Hi tone (see Section 3). A similar close association between tones can be observed for the AP-final H* and the preceding L tone: the majority of AP final boundaries are marked by rising pitch movement, LH*, where the L tone is realized on either the same syllable as the H* tone or on the immediately preceding syllable.

Therefore, we propose here to revise the tonal association within AP. Figure 1 shows the hierarchical structure of French intonation and the affiliation of tones to syllables and prosodic constituents. We consider the initial LHi sequence of an AP to be a “phrase accent” marking the initial boundary of an AP. As shown in Figure 1, LHi is not linked to a particular syllable within an AP but is associated with the constituent boundary, i.e. the AP initial edge. That is, LHi is a property of the phrase. As mentioned earlier, the realization of L or Hi is optional, and when Hi is realized, the location is variable. As we will see in the examples presented in the next sections, the location of Hi is sensitive to wordhood, so that its default location is one of the initial syllables of the first content word of the AP. However, when the first content word is preceded by many clitic syllables (4 or more), Hi can be realized on one of the function words preceding the first content word (see Section 4 for more detail). The L part of the LHi phrase accent is also optional, but is realized more consistently than the Hi tone. When it is realized, it occurs at the beginning of the AP and can spread over all of the clitic syllables preceding the AP initial content word (see, e.g., Figure 7) or the function word carrying the Hi tone (e.g., Figure 8). However, it should be noted that, though the realization of L or Hi is optional, one of these must be realized to mark the AP initial boundary.

The right boundary of an AP is marked by a final rise, represented by LH*. LH* has a double association as shown in Figure 1: LH* marks the right edge of an AP, but H* is also associated with the stressed syllable of an AP, i.e., the final full syllable of the last content word of an AP. This reflects H*'s association with the most prominent syllable within a phrase and its demarcative function. We consider this LH* tone to be a “pitch accent” because part of the tone is associated with a stressed syllable at the phrasal level.⁴ The realization of the L tone is more variable because it is not associated with any specific syllable. It is often realized on the syllable immediately preceding the H*, i.e., on the penultimate syllable of the AP, but is sometimes realized on the final syllable together with H*, resulting in a contour tone (e.g., see Figure 8b), and it is sometimes not realized at all due to a lack of time/space or tonal context (see Figure 4b).

4. Note that this definition is different from the term ‘pitch accent’ as it is used for Germanic languages where it is associated with a *lexically* stressed syllable.



IP	Intonation Phrase	Wc	content Word
AP	Accentual Phrase	σ	Syllable
Wf	function Word	%	IP boundary tone

Figure 1. Hierarchical structure of French intonation and the affiliation of tone to syllable/structure.

In sum, an AP is demarcated by an AP initial rising tone (the phrasal accent LH_i) and an AP final rising tone (the pitch accent LH*). Therefore, the different nature of these two H tones becomes clearer in the current version of our model than in the previous one. This aspect of our model differs from models in which these accents are considered the same, i.e., pitch accents in Post (2000) or Tonal Units in the model of Di Cristo and Hirst (Di Cristo and Hirst 1993, Hirst and Di Cristo 1996, Di Cristo 1999) (see Section 5 for more detail).

Syllables not affected by initial or final LH tones, i.e., syllables in between the Hi-syllable and the final L-syllable, get their surface pitch value through interpolation between Hi and L. This means that, as we have claimed earlier (Jun and Fougeron 1995, 2000), the falling slope of the intonation contour between Hi and the following L (i.e., 'A' in Figure 2a) is inversely correlated with the number of syllables in between: the slope is shallower when the number of syllables increases, as shown in Figure 2b. A similar phenomenon is found in Japanese (Pierrehumbert and Beckman 1988, Figure 1.3) and Korean (Jun 1996, 1998). On the other hand, the falling slope from H* to the following L across an AP boundary (i.e., 'B' in Figure 2a) does not vary depending on the number of syllables in between. Rather, it is fairly constant, about 100 to 200 msec, regardless of the number of syllables in between (Jun and Fougeron 1995, 2000). This is due to the fact that both H* and the following L are linked to the boundaries of an AP (final and initial boundaries respectively). The difference in the slope of the fall after the LH_i and LH* accents is one of the strongest argument for us to reject the Tonal Unit (TU) of Hirst and Di Cristo's model where each sequence of LH tones forms one TU regard-

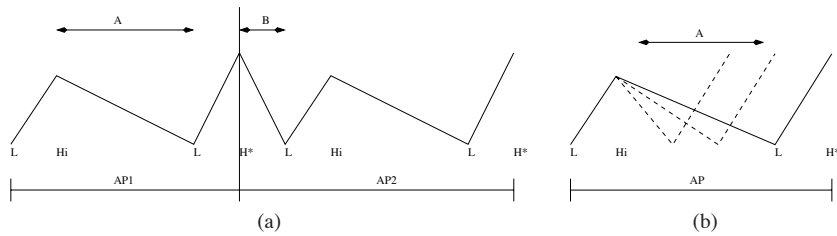


Figure 2. (a) Schematic F_0 contour of two APs illustrating the slope difference between two falling tones: Hi to L within an AP ('A') vs. H^* to L across AP ('B'). (b) The falling slope over 'A' becomes shallower as the number of syllables of AP increases. (But the falling slope over 'B' in (a) is fairly constant.)

less of word boundaries and the grouping of TUs are independent of their tonal shape.

Higher than an AP and in fact the highest prosodic constituent defined by intonation in this model is the Intonation Phrase (henceforth IP). An IP contains one or more APs. It is demarcated by a phrase final boundary tone (e.g., $H\%$, $L\%$), realized on the last syllable of the phrase, and marked by significant lengthening of the phrase final syllable. It is optionally followed by a pause. There is no IP initial boundary tone, and utterance initial tone is attributed to the AP initial tone (LHi). When the AP is the last AP of an IP, the AP final syllable is also the IP final syllable, and in this case, the AP final H^* (linked to the AP final syllable) is pre-empted by the boundary tone of the IP. Therefore, the surface tonal pattern of an IP-final AP is LHiLL% (as shown in Figure 4a), HiLL% (as in Figure 3, 4b–d), or LHiLH% (as in Figure 6a–b). However, the interaction between the IP-final-pitch accent and the boundary tone may need to be modified depending upon the inventory of IP boundary tones, and further work is needed to ascertain the inventory of IP boundary tones and their realizations and meanings in French.

In Jun and Fougeron (2000), we discussed evidence for a possible intonationally marked unit intermediate between the AP and the IP. The depiction of tone shapes for final APs would be modified if we were to adopt the intermediate phrase, but not in ways that would change our analysis of the AP patterns that we discuss in the current paper.

3. Variants of AP tonal pattern

Based on our model in Figure 1, the fully realized tonal pattern of an AP is LHiLH*. This is the most common and default tonal pattern of the AP in Parisian French. However, depending on several factors such as the number

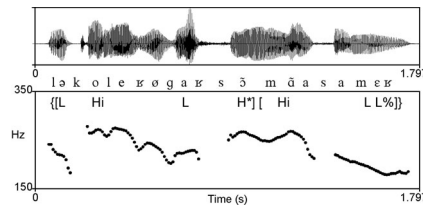


Figure 3. F_0 track of 'le coléreux garçon ment à sa mère'. Speaker 1F

of syllables in the phrase, speech rate, speech style, the location of the phrase, the type of adjacent tones, or simply the speaker, APs are not always realized as such. In the data we have examined thus far, we have observed five variants of the basic AP tonal pattern. They are LH* (when none of the AP medial tones are realized), LLH* or LHiH* (when one of the medial tones is not realized), and HiLH* or LHL* (when either the initial or final tone is not realized). These patterns suggest that, even though the LHi phrase accent and the LH* pitch accent are basic tonal components of an AP, it is not necessary for all four tones to be realized simultaneously. Rather, it is possible for only a subset of the tones to be realized due to several constraints.

The pitch contours in the figures below illustrate all six types of AP tonal patterns: the default and the five variants of AP tonal pattern. These patterns come from data recorded in a laboratory where Parisian French speakers read a set of sentences and a story. In most cases, the resulting APs contained at most two function words and were not longer than seven syllables.

Figure 3 shows an example pitch track of LHiLH* (*Le coléreux garçon ment à sa mère* 'The choleric boy lies to his mother'), i.e., the default tonal pattern for an AP when all four tones are realized. This sentence is uttered in two Accentual Phrases: {[*Le coléreux garçon*][*ment à sa mère*]} (with [] for AP and { } for IP). The initial two words (six syllables), '*Le coléreux garçon*' form one AP showing the LHiLH* pattern (with the initial L on *le*, Hi on *co-*, L on *gar-* and H* on *-çon*). The F_0 value over *-léreux* is gradually falling, due to the interpolation between Hi on the preceding syllable and L on the following syllable *ga-*. The rest of the words in the sentence forms another AP with a HiLL% pattern (L% because the AP is the last AP of an IP with a L% boundary tone). In this case, 'ment' is realized with a Hi tone with the phrase initial L tone being undershot due to a lack of time/tone bearing segment. The same pattern is shown in Figures 4b–d.

Figure 4a shows an example pitch track of LH* (*Marion mangera des bananes* 'Marion will eat some bananas'). This sentence is uttered in three APs: {[*Marion*][*mang(e)ra*][*des bananes*]}]. The first and second APs show the LH* pattern with the L part of the phrase accent realized on the first syllable of the

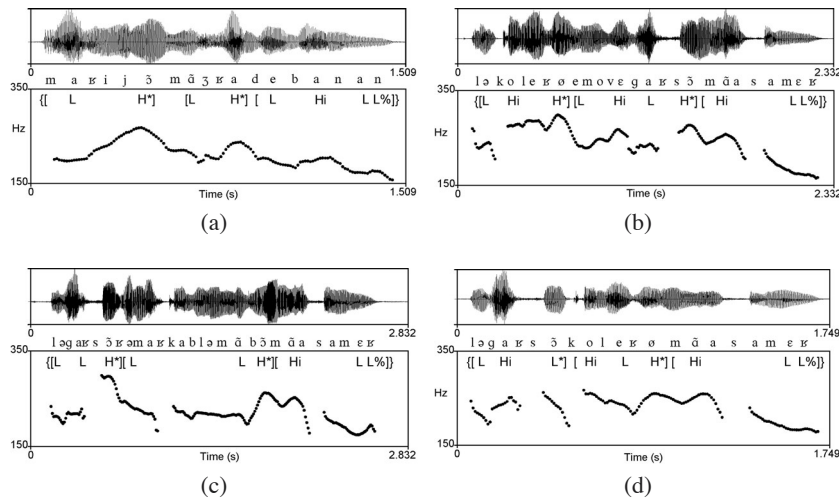


Figure 4. F_0 tracks of (a) ‘Marion mangera des bananes’, speaker 1F, (b) ‘Le coléreux et mauvais garçon ment à sa mère’, speaker 1F, (c) ‘Le garçon remarquablement bon ment à sa mère’, speaker 1F, (d) ‘Le garçon coléreux ment à sa mère’, speaker 1F

AP and a gradual rise until the final syllable carrying the H part of the pitch accent. The last AP shows a LHiLL% pattern with the realization of the L part of the phrase accent over the function word *des*, the Hi part of the phrase accent on the first syllable of the first content word *ba*, and LL% on the IP final syllable.

Figure 4b shows an example pitch track of LHiH* (*Le coléreux et mauvais garçon ment à sa mère* ‘The choleric and bad boy lies to his mother’). This sentence is uttered in three APs: {[*Le coléreux*][*et mauvais garçon*]][*ment à sa mère*]}. The first AP shows LHiH* pattern with L on the article *le*, Hi on *co-* (with a sharp rise from the preceding L), and H* on *-reux*. The L tone of the LH* pitch accent is undershot, so that F_0 remains high between the Hi and H* tones. The second AP of Figure 4b shows a LHiLH* tonal pattern, with a L tone on the clitic syllable *et*, a gradual rise until Hi on the second syllable of the first content word *-vais*, a L tone on *ga-* and H* on *-çon*.

Figure 4c shows an example pitch track of LLH* (*Le garçon remarquablement bon ment à sa mère*. ‘The remarkably good boy lies to his mother’). This sentence is uttered in three APs: {[*Le garçon*][*remarquablement bon*]][*ment à sa mère*]}. The first and the second AP show the LLH* pattern, in which the Hi part of the phrase accent is not realized. In the first AP *Le garçon*, the L part of the phrase accent is realized on the article *le* and the LH* pitch ac-

cent is realized on the bisyllabic content word with H* on the final syllable and L on the preceding syllable (here the first syllable of the word). In the second AP, the F₀ value over *remarquablement* is low and flat until the last syllable/word *bon*. Here, the L part of the phrase accent is realized on the first syllable of the AP *re-* and the LH* pitch accent is realized on the penultimate and final syllable of the AP, respectively. The low flat F₀ over *-marquable-* is due to the interpolation between the initial L and the L part of the pitch accent. The second AP, where the AP initial H tone (Hi) is not realized even though the AP is longer than three syllables, i.e., enough syllables to carry four tones, illustrates that the realization of Hi is not always conditioned by time constraints.

Among the five non-default tonal patterns, LH*, LLH* and LHiH* are common when the AP has fewer than four syllables, and, among these, LH* is the most common. This suggests that there is a tendency to preserve the peripheral tones of both the phrase accent and the pitch accent when there is not enough time to realize the full accents. This suggests that there is a constraint on tone realization: ‘PRESERVE PERIPHERAL’ (preserve peripheral tones when a phrase is short). For the other two types, LLH* and LHiH*, we are uncertain as to what determines the choice of the non-peripheral tone that will be realized. As noted in the introduction, the realization of initial stress in French is conditioned by many factors, including speaker and style. The example shown in Figure 4c illustrates this well-known “probabilistic” nature of initial stress in French (“l’accent probabilitaire” in Fonagy 1979) by presenting an example of a sequence of 5 syllables without H tones. The other two non-default AP tonal patterns (HiLH* and LHiL*) involve undershoot of peripheral tones. In the first case, the L part of the phrase accent cannot be realized, resulting in HiLH* pattern, and in the second case, the H* part of the pitch accent cannot be realized, resulting in LHiL* pattern. The HiLH* tonal pattern has been found to be frequent when the AP begins with a content word rather than a function word. The last APs of Figures 3 and Figures 4b-d show example pitch tracks of HiLH* (see also the second AP of Figure 4d). However, we observed that, when an AP begins with a content word and when this AP is initial in an IP, the L part of the phrase accent tends to be maintained and is realized on the first syllable of the content word, whether it is followed by Hi (Figures 5 and 6) or not (Figure 4a).

The LHiL* pattern is the least frequent AP tonal pattern among the five variants we have observed. This pattern has been found to occur in cases where the pitch accent is immediately preceded by Hi and followed by Hi. An example pitch track is shown in Figure 4d (*Le garçon coléreux ment à sa mère*. ‘The choleric boy lied to his mother’; with the adjective postponed ‘boy choleric’). This sentence is uttered in three APs: {[*Le garçon*][*coléreux*][*ment à sa mère*]}. The first AP shows the LHiL* pattern, and the second AP shows the HiLH* pattern.

That is, the pitch accented syllable, *-çon*, is flanked by two Hi-toned syllables, *-gar* and *co-*. In this case, the H* part of the pitch accent is not realized. Instead, the syllable is realized with a L tone, L*, possibly to provide a better cue for the phrase boundary. This suggests an avoidance of three consecutive H tones, *[HiH*Hi], when there are no toneless syllables or a L tone between the H-toned syllables. This tendency could be represented with the constraint 'AVOID HHH'. However, since Hi can be immediately followed by H* in the same AP, and H* can be immediately followed by Hi in the following AP, this suggests that a sequence of two H tones is allowed if these tones are different in nature, i.e., phrase accent vs. pitch accent. Nevertheless, a sequence of three H tones is not tolerated. Cases such as these have been analyzed in some prior accounts (e.g., Post 2000) as examples of stress clash resolution. That is, the low pitch on the stressed syllable is equated with de-accenting. However, the final syllable still bears all the other hallmarks of stress, such as lengthening. Clearly then, what is changed is not the degree of stress, but the tone. (Further, even if we assume that a H tone equals stress, stress clash would still not happen because the H tone following H* does not belong to the same prosodic unit). At the moment, it is not clear if there is a distinctive meaning linked to the L* final AP compared to H*. Because the majority of AP final tones are H* and also because L* is somewhat predictable, we assume that H* is the default tone marking for an AP final boundary.

It appears that none of these surface tonal variations have a distinctive meaning, and what is important for the perception of an AP is the percept of a rising tone together with the long and loud final syllable. A further study is needed to determine the conditions under which each of these AP patterns would be used, or whether there is simply free variation. Additionally, we have suggested two constraints on tonal realizations in this section, and we anticipate that proper rankings of these and a few more constraints will produce the correct tonal pattern. However, this is beyond the scope of this paper.

4. Exceptional cases

We have seen so far that an AP can be realized in six different ways, but all of these variations show at most two H tones (initial Hi and final H*). However, when an AP contains a polymorphemic word longer than 7 syllables, H tone tends to occur more than twice. A similar phenomenon can also occur when there are more than three clitics (function words) before a content word. In this case, an H tone tends to occur on one of the clitics before the initial syllable of the content word. This suggests that an AP can have more than two H tones or that a sequence of clitics or a part of a polymorphemic word can form an AP. In this section, we will show some example pitch tracks of long polymorphemic

words and phrases containing a sequence of several clitics and discuss how to account for these tonal patterns in our model.

As noted by several authors, the distribution of H tones, or accent, in French relies on several principles, some of which are rhythmic in nature. For example, Verluyten (1984), Dell (1984), Martin (1986), Padeloup (1990), and Delais-Roussarie (1995) posit principles that constrain the number of unaccented syllables (i.e., non-H-toned syllables) or the alternation of accented/unaccented syllables in a group. For example, phrasings have to respect a eurhythmic principle (rhythmic equilibrium and recurrence principle), and accents must not be too close or too far from one another. In consequence, a rhythmic structure with a regular repetition of groups of equivalent size is preferred. Although these principles are not always found in spontaneous speech, it is generally agreed that, in read speech, accent groups tend to avoid being too short or too long. Along the same lines, it is also noted that a sequence of syllables without an H tone usually does not extend to beyond three (Delais-Roussarie 1995) or four (Padeloup 1990, 1992) syllables.⁵ Therefore, when a group contains ‘too many’ unaccented syllables, a process of ‘over-accentuation’ (that is, more than two H-tones in a group) may apply. So the question that remains is: when a phrase is “over-accented”, what is the nature of the additional H tone – is it a pitch accent, a phrase accent, or something else entirely?

4.1. *Polymorphemic words*

Padeloup (1990) has observed “over-accented” cases in long polymorphemic words (e.g., *c’est anTIconstiTutionNEL* ‘It’s anticonstitutional’) and has proposed considering these word-medial H-tones as demarcative, and thus as primary stress tones. On the other hand, Delais-Roussarie (1995) reported a similar pattern for polymorphemic words (e.g., *POLyMORpheMIQUE*) and considered the word-medial tone to be an “accent régulateur rythmique” (rhythmic regulatory stress), and further claimed that, in this case, the rhythmic H tone serves to demarcate morphological units. She also claims that the same accent is used to demarcate a lexical unit, as in *le GENtil CHIMpanZE* (‘the nice chimpanzee’), i.e., one rhythmic unit with two rhythmic accents and one final accent.

In the examples of polymorphemic words that are presented below, we have tried to determine the nature of these H tones by having speakers pronounce what would traditionally be considered as one accentual group (a word), but with an increased number of syllables in that group.

5. Padeloup (1992: 339) states that stress is generally distributed on an average of 1 stress (primary or secondary) per 3 syllables.

Among the polymorphemic words we analyzed, the longest word was *anti-constitutionnellement* ‘unconstitutionally’. This word was pronounced with 8 or 9 syllables depending on whether the schwa in *-lement* was pronounced. The four panels in Figure 5 present various repetitions of this word pronounced with 9 syllables.⁶ This figure shows that, although this word can be pronounced with the default AP tonal pattern LHi LH* (Figure 5a), the word can also be pronounced with more than one word-internal LH tone. These additional rising tones have been labeled in the figure as LH’s. One can see that they appear in various locations, but are not random. If there are two or more H tones before the H* tone, the first H tone is almost always realized on the second syllable of the word (*ti*), and the last H tone appears on *nel*. When there are three H tones before the H*, the second H tone appears on *tu* (Figure 5c) or on *sti* (Figure 5d). These examples also show that an L tone is realized on the syllable immediately preceding the H toned syllable (i.e., *an*, *tion*, *ti*, *con*). Note that in the last two examples the word is produced in one IP (and one AP), and that may account for the presence of more H tones.

We argue that the first H tones (on *anTI* in Figures 5a, 5b, and 5c) and the second H tone on *STI* in Figure 5d are phrase accents, not pitch accents, for three reasons. First, these non-AP-final H tones are optional and are not associated with any specific syllable, as their location is variable. Second, the syllables on which these H tones appear are not systematically longer or louder than non-H toned syllables. Third, the falling slope between H and the following L, when there is at least one syllable in between H and L, is gradual. If the H tone is pitch accent, the falling slope between this H* and the following L (i.e., AP initial phrase accent) would have been sharp (as explained in Figure 2). A gradual falling slope is indeed found over *TIconstitutionnelle* in Figure 5a, over *TIconstitution* in Figure 5b, over *TIconsti* in Figure 5c, and over *STItusion* in Figure 5d. The argument based on the falling slope cannot be used for the other H tones (on *NEL* in Figure 5b–d and on *anTI* in Figure 5d) since there is no syllable between the H and the following L tone. However, the variability of H tone location suggests that these additional H tones are phrase accents, not phrase boundary tones (i.e., pitch accents). This matches native speakers’ impressions of the absence of juncture after these H tones, as well.

6. Although the pronunciation of the schwa may seem unusual for Parisian French speakers, all three of our speakers realized it. This is probably due to the fact that they had to read the sentences. The addition of the schwa allowed them to produce a H tone on the antepenultimate syllable (*el*). This would probably not have been the case if they had not pronounced the schwa. Padeloup (1990) reports that the penult is not stressable in French regardless of whether or not the final syllable carries the primary stress. She says that this is probably due to stress clash, although she later claims that stress clash occurs only between stresses of the same nature.

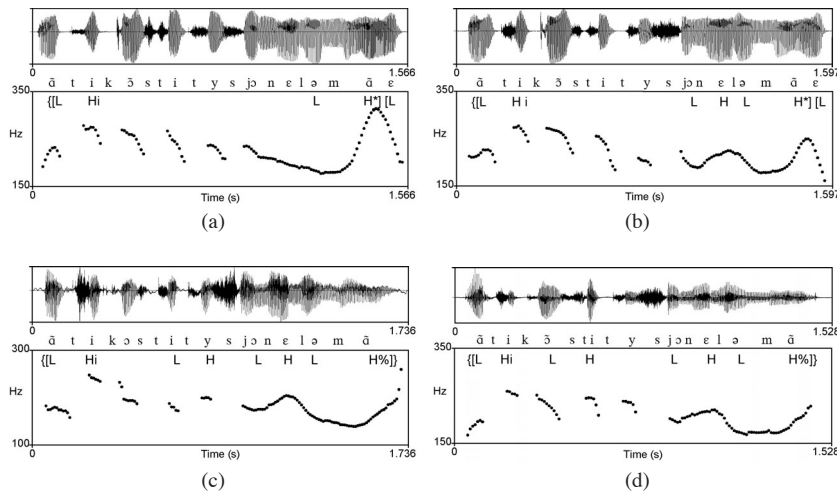


Figure 5. F_0 track of four realizations of the long polymorphemic word *anticonstitutionnellement* taken from the utterance *Anticonstitutionnellement est un mot utilisé par les français* ('Unconstitutionally is a word used by the French'). (a) and (b) by speaker 2F, (c) by speaker 5F and (d) by speaker 3F.

This means that a long AP can have more than one phrase accent, and that the LH tones after the initial LH_i can occur according to two rhythmic constraints: the avoidance of having H tones on adjacent syllables and of having a sequence of four or more syllables without H tones.⁷ The occurrence of these additional LH tones also appears to be influenced by the morphological structure of a word. Data show that there is a tendency for these LH tones to appear close to a morpheme boundary.

The fact that the first H tone in Figure 5a–d is almost always on *ti* does not indicate whether or not the location of this Hi is determined from the rhythmic principle or the presence of the morpheme boundary after *anti*. However, the examples presented in Figure 6 show that the location of Hi in other (long, polymorphemic) words is not influenced by the location of a morpheme boundary, but by the rhythmic principle; here on the 3rd syllable of a polymorphemic word: *indiVI dualisation* 'individualization' in Figure 6a and *inconSTITutionnel* 'unconstitutional' in Figure 6b.

7. Note however that this constraint is not respected in the cases where only one initial H tone is produced on the second syllable of the word, as in the rendition shown in Figure 5a. In these cases we observe a sequence of six syllables without a H tone.

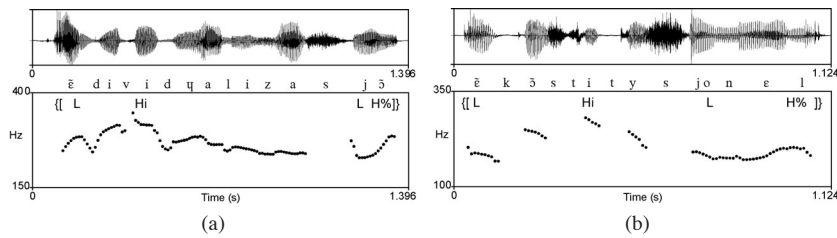


Figure 6. Examples showing Hi being not on a morpheme boundary of a long word. (a) for the word *individualisation*, speaker 2F; (b) for the word *inconstitutionnel*, speaker 3F. Both words were read in the sentence *X est un mot utilisé par les français*.

Examples in Figures 5 and 6 show that the preferred location of the AP phrase accent is on one of the first syllables of the phrase as predicted by our model, and when an extra phrase accent is realized, it is most often on the antepenultimate syllable of the phrase (here, *-nel* in Figure 5b–d). This accords with the finding in Padeloup (1992) that the total number of secondary stresses (= our phrase accent) can be broken down to give approximately 80 % on the 1st syllable of a word (= one of the three initial syllables in our data) and 20 % on the antepenultimate syllable of a word.

4.2. Long clitic sequence

Previous studies have shown that, in general, lexical words can receive accents but function words, or clitics, cannot (e.g., Garde 1968; Di Cristo 1999). Only clitics with certain properties can receive a H tone. For example, Di Cristo and Chafcouloff (1975) found that clitic subjects are often accented when they occur in the initial position of utterances or Intonation Phrases. Enclitics behave differently from proclitics in that they can be accented and carry primary pitch accent (H*), e.g., *donne-LUI* ‘give him’, *regarde-LA* ‘look at her’ (see Mertens 1993, Delais-Roussarie 1999). Proclitics are not accented in general, but for the few cases where they are, monosyllabic proclitics are less likely to be accented than disyllabic proclitics. When a monosyllabic proclitic is accented, it is a demonstrative personal pronoun (e.g., *ceux* ‘these’), a tonic pronoun (e.g., *moi* ‘me’, *lui* ‘him’), or a negative adverb (e.g., *pas* ‘not’, *plus* ‘no longer’) (Delais-Roussarie 1995)⁸. Finally, interrogative pronouns (e.g., *qui* ‘who’) and

8. Delais-Roussarie (1995) showed that, among clitics that were accented (10 %), her ‘initial stress’ was more frequent (83 %) than primary stress.

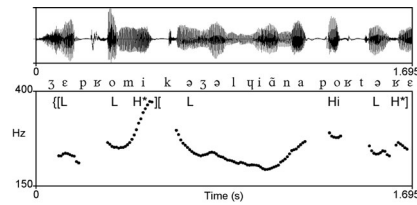


Figure 7. F_0 track of *j'ai promis que je lui en apporterai* containing 4 clitics without H-tone. Speaker 4F

polysyllabic prepositions (e.g., *pendant* 'while', *depuis* 'since') can also be accented (Delais-Roussarie 1995).

However, clitics without these properties can still receive phrase accents due to a rhythmic constraint. That is, when an AP begins with four or more monosyllabic clitics before a content word, we observed that phrase accent could be realized on one of the monosyllabic clitics. When there are seven or more monosyllabic clitics before a content word, more than one phrase accent can occur on clitics following the same rhythmic constraints as in the long polymorphemic words: the avoidance of having H tones on adjacent syllables and of having a sequence of four or more syllables without H tones.

We believe that the H tone on the clitic is the phrase accent for the same reasons mentioned in Section 4.1 above. The H tone is optional and its location varies across speakers and repetitions, and the syllable does not show any lengthening or increased intensity. In this section, we will illustrate utterances where several clitics occur before a content word. The data show that H tones occur on clitics when there are more than three or four clitics before a content word and that, as in the polymorphemic words, more than one H tone can occur as the number of clitics increases. It is also shown that the location of these H tones varies across repetitions and across speakers.

Figure 7 shows a sequence of four clitics without any H tones, while Figure 8 shows a sequence of four clitics with one H tone. Figure 7 shows an F_0 track of *j'ai promis que je lui en apporterai*.⁹ The L part of the initial phrase accent of the second AP marks the beginning of the phrase and a Hi tone is realized on the second syllable of the content word, *apporterai*. The L phrasal tone spreads rightward until the beginning of the content word.

9. Figure 7 is a part of the utterance *J'aime offrir du chocolat à mon fils. D'ailleurs, j'ai promis que je lui en apporterai un gros morceau*. 'I like to offer chocolate to my son. Indeed, I promise that I will bring him a big chunk'. The clitic sequence (underlined) literally means 'that – I – him – some'.

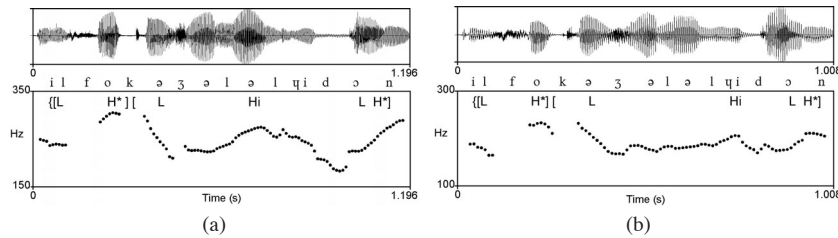


Figure 8. F₀ track of *il faut que je le lui donne* containing 4 clitics, showing an H tone on one clitic: *le* in (a) by speaker 4F and *lui* in (b) by speaker 3F.

Figure 8 shows F₀ tracks of *il faut que je le lui donne* produced by two speakers.¹⁰ Among the sequence of four clitics, Figure 8a shows a Hi tone over the third clitic *le*, and Figure 8b shows a Hi tone over the fourth clitic *lui*. Using the same criteria as those applied to long words, we conclude that the H tone on the clitic in Figure 8a is a phrase accent. The L tone after the Hi is not on the immediately following syllable but on the final syllable of the phrase, thus showing a gradual falling contour. The nature of the H tone on *lui* in Figure 8b cannot be determined using the slope criteria because there is no intervening syllable between this H and the following L. Based on the juncture after this syllable and the phonetic properties of the H toned syllable, however, we believe that this H is also Hi. Note that in Figures 8a–b and Figure 9b the phrase initial L tone spreads rightward up to the syllable immediately preceding the Hi-toned clitic syllable. These examples also show that the tone of the phrase final syllable, *donne*, is LH*, demonstrating the realization of L on the same syllable as H*.

Figures 9a and 9b illustrate examples of one phrase accent extending over five and seven clitic sequences, respectively, and Figures 10 and 11a show examples of two phrase accents distributed over sequences of six clitics. This suggests that, even though a clitic is more likely to receive phrase accent as the number of clitics increases, after a certain point, it is not necessarily true that the longer the clitic sequence, the greater the number of phrase accents.

Figure 9a shows the F₀ track of *il faut que je le lui en donne*¹¹, which has one more clitic than the example in Figure 8. In the sequence of five clitics, the F₀ peak occurs on the 2nd clitic (*je*). We believe this F₀ peak is the Hi part

10. Figure 8 is a part of the utterance *Il attend toujours son goûter. Après la classe, il faut que je le lui donne tout de suite*. 'He is always waiting for his afternoon snack. After school, it is necessary that I give it to him as soon as possible'. (that – I – him – it)

11. Figure 9a is a part of the utterance *Il adore le chocolat. Après la classe, il faut que je le lui en donne tout de suite*. 'He loves chocolate. After school, it is necessary that I give him some as soon as possible.' (that – I – him – it – some).

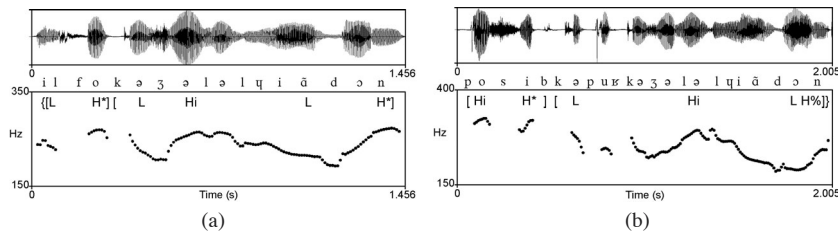


Figure 9. F_0 tracks of (a) *il faut que je le lui en donne* containing 5 clitics, with a Hi tone on *je*, speaker 4F, and (b) *possible que pour que je le lui en donne* containing 7 clitics, with a Hi tone on *le*, speaker 4F

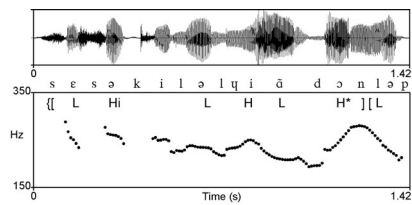


Figure 10. F_0 track of *c'est ce qui le lui en donne le p...* containing 6 clitics, with two phrase accents. Speaker 4F

of the LHi phrase accent, as the F_0 is continuously falling after *je* until *en* and then rises to the monosyllable content word. That is, the syllables *le lui* do not carry a tone. Their F_0 pattern results from interpolation between the Hi on *je* and the L tone on *en*. Figure 9b shows the F_0 track of a portion of an utterance with seven clitics, (*possible que pour que je le lui en donne*¹²) with a H tone occurring on the 5th clitic (*le*). Again, we categorized this F_0 peak as the Hi part of the phrase accent because the falling slope after Hi is shallow, reaching the minimum during the final syllable.

On the other hand, Figure 10 shows a sequence of six clitics *c'est ce qui le lui en*¹³, containing two clitics with H tone: *ce* and *lui*. We believe the first H on *ce* to be the Hi part of the phrase accent because of the continuous fall from *ce* to *le*. For the H on *lui*, the falling slope is not relevant since there is only one syllable between the H and the following L, but based on the phonetic

12. Figure 9b is a part of the utterance *Il est possible que pour que je le lui en donne, il faille le faire venir*. 'It is possible that in order for me to give some (chocolate) to him, we would have to make him come.' (that – for – that – I – it – him – some).

13. Figure 10 is a part of the utterance *Il y a des aliments qui lui donnent des boutons. La charcuterie, c'est ce qui le lui en donne le plus*. 'There are some foods that give him pimples. Cold meats, that's what gives him the most.' (that's – what – that – it – him – some).

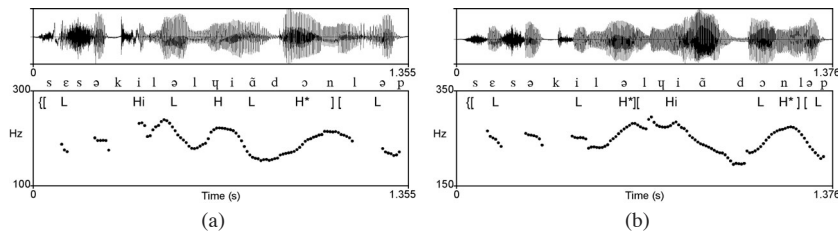


Figure 11. F_0 tracks of *c'est ce qui le lui en donne le p...* Same as the sentence in Figure 10, but with two H toned clitics at different locations. (a) by speaker 3F, (b) by speaker 4F.

properties of the syllable (namely, weaker pitch peak and weaker juncture than those associated with H^*), we categorize it as a phrase accent. This means that the Accentual Phrase in Figure 10 has two phrase accents and one pitch accent. Figure 11a shows another example of two phrase accents in one AP.

Figure 11 shows two other renditions of the sentence presented in Figure 10 (six clitics plus a monosyllabic content word), but with different H-toned clitics. Figure 11a shows H on alternating syllables, *qui* (3rd) and *lui* (5th)¹⁴ and Figure 11b shows H on the adjacent syllables *le* (4th) and *lui* (5th). Based on the phonetic properties of the H-toned syllables and the degree of juncture following them, we believe that both H tones in Figure 11a are phrase accents. Since the H tones are on alternating syllables, the falling slope argument is irrelevant.

However, in Figure 11b the first H tone seems to be different from the other H tones observed over clitic syllables. The syllable *le* here is more prominent than the adjacent syllables and is also more prominent than those in the other examples (Figure 11a and Figure 10). Further, it is immediately followed by another H tone which falls slowly until the pitch accented syllable, *donne* (compare the location of LH^* in this example with that found in the other examples). This suggests that in this rendition the speaker has produced the sequence into two APs, [*c'est ce qui le*] and [*lui en donne*]. That is, the first H in 11b is H^* and the second H is H_i . Thus, the sequence of two H tones over the 4th and 5th syllables in Figure 11b is fully acceptable in our model, which suggests that a sequence of two H tones can occur on adjacent syllables in French unless both of them are phrase accents (H_iH_i) or pitch accents (H^*H^*). That is, the constraint on sequences of accents is similar to the constraint on stress clash proposed by Padeloup (1990) (see Footnote 2). Specifically, accent clash occurs only between accents of the same nature. This also implies that a sequence

14. Note that the perceptually highest peak is on *qui*, but due to pitch perturbation the beginning of *le* appears high; since F_0 is falling over the schwa after *l*, the phonological tone on *le* is L.

of clitics can form an AP, depending on such factors as the rhythmic constraint and pragmatic meaning.

5. Discussion and conclusion

So far we have presented various realizations of the Accentual Phrase in French and the distribution of H tones over long words and sequences of clitics. In this section, we will discuss the nature of the H tones and the constraints on their distribution and will further clarify our model.

The nature of H tones

When an AP contains fewer than seven syllables, its realization includes at most two H tones: that of the initial phrase accent (LHi) and that of the pitch accent (LH*). When there is only one H tone, it can be the initial phrase accent (e.g., LHiL*) or the pitch accent (e.g., LH* or LLH*), depending on the location of the H tone, though the latter is much more common than the former. When an AP has fewer than four syllables and has two H tones, these H tones can occur on adjacent syllables (e.g., LHiH* in three syllable APs), though the H tones are not likely to occur on adjacent syllables when there are more than four syllables (see below).

In the previous version of our model (Jun and Fougeron 2000), we claimed that the initial H and final H tones were different in nature. We asserted that the final H was a pitch accent (H*) but the initial H (Hi) was not. The different nature of these two accents is supported by the fact that the tone-syllable affiliation is fixed for H*, but not for Hi, and that H* is obligatory in an AP, whereas Hi is optional. These accents also differ in their phonetic properties. The prominence of H*, indicated by loudness and lengthening, is greater than that of Hi. Finally, H* marks the right edge of a prosodic boundary, while Hi does not. That is, F₀ rising to Hi is internal to a phrase and the falling slope after Hi depends on the number of syllables occurring between the Hi and H* syllables, while the falling slope after a H* is steep and consistent.

This claim was contra to Post (2000) who considers both H tones to be pitch accents,¹⁵ and also contra to Hirst and Di Cristo's model (e.g., Hirst and Di

15. Post (2000) distinguishes tone structure from prosodic structure. Two accents are pitch accents because they show high pitch. The fact that the primary accented syllable is longer than the initial accented syllable is not because they are of a different nature, but because the primary accented syllable is the last syllable of the phrase, i.e., due to phrase final lengthening. This is similar to the approach taken by Di Cristo and Hirst (1993, 1996). Their Tone Unit is based purely on the tone, and the lengthening is determined by the Rhythmic Unit.

Cristo 1996, Di Cristo 2000) in which all F_0 rises are treated equivalently – i.e., as Tonal Units. A Tonal Unit (TU) in their model is a sequence of LH tones, regardless of the presence of a word boundary in between, and is smaller than our AP. Hirst and Di Cristo (1996) have argued against our model, and, as an argument in favor of their TU, they pointed out that our AP could not account for the occurrence of more than two accents in a long polymorphemic word, such as *la POLySYllabicit e*. In their model, this would be represented by three Tonal Units within a single Rhythmic Unit (RU), where the RU is a higher prosodic level than the Tonal Unit, not defined by tone. For example, <(LH)(LH)(LH)> represents one RU containing three TUs (with parentheses surrounding TUs and angle brackets surrounding the RU). They have suggested that we would need to introduce a special contour <LHLHLH> to account for this pattern in our model.

In this paper, we have analyzed APs with more than two LH tones, and suggested that the additional LH tone is a phrase accent, akin to the rising tone in phrase initial position, (i.e., the phrase initial L and Hi tones presented in the previous version of our model). That is, we categorized both initial and medial rising tones as phrase accents, though we chose to transcribe LHi for the initial one and LH for the medial one for clarity. Although a comprehensive phonetic analysis of the medial LH tones remains to be done, we have observed from our data that these medial LH tones differ from the final LH* tone but share the same properties as the initial LHi phrase accent. For instance, they have a shallow falling slope after the H tone if there are any toneless syllables after it, thereby demonstrating a phrase medial property. Further, their realization is optional, and the location of the H tone is variable. Finally, the phonetic properties of the H tone seem to be weaker than those of the pitch accent (i.e., final LH*).

Constraints on the distribution of phrase accent

We have seen from the examples of long polymorphemic words and sequences of multiple clitics that a LH phrase accent can occur more than once. (So far, we have seen a maximum of three LH phrase accents in one AP, regardless of whether the syllables come from content words or function words). From

Our model, however, assumes that, at the level of the accentual phrase, the accentual structure defines prosodic structure. That is, the primary accent demarcates the end of the phrase. Therefore, we cannot determine whether lengthening is due to the accent or phrase final lengthening (i.e., both tone and lengthening coexist in H*). Note, however, that phrase final lengthening is not a necessary condition for a prosodic unit. Accentual Phrases in Korean (Jun 1998, 2000) and Japanese (Pierrehumbert and Beckman 1988; Ueyama, 1999) do not have phrase final lengthening, though Intonation Phrases in both languages have phrase final lengthening.

the data we have observed, it appears that this realization of an AP with more than one phrase accent is exceptional. The occurrence of a medial phrase accent is conditioned by the length of the AP (i.e., it occurs only when the AP is longer than six syllables), and moreover it is found to occur only when the length of the AP is due to an overlong sequence of syllables that are in general not susceptible to pitch accenting. Thus, medial phrase accents appeared in APs containing a single long content word (i.e., with a single pitch accent) and in APs containing a single content word (carrying the pitch accent) preceded by many clitics. For sequences of several content words with a few clitics in between, we have not observed a grouping of content words into a single AP with the occurrence of a medial phrasal accent. For example, a sentence like *les ananas de la voisine* ('the pineapples of the neighbor') would be realized either in a single AP with the default tonal pattern LHiLH* ([les Ananas de la voiSINE]) or as two APs ([les anaNAS] [de la voiSINE] or [les AnaNAS][de la voiSINE]), but it would not be realized as one AP with a medial phrase accent (i.e., *[les AnaNAS de la voiSINE]). In other words, it seems that the medial phrase accent does not occur when an AP has two content words and both of them are not short. When an AP is longer than six syllables and contains two content words, the string will be produced in two APs with each content word forming one AP. Further data should be examined to confirm this observation. Furthermore, since the current data on the clitic sequences are based on monosyllabic clitics, we also need to observe the tonal patterns found in polysyllabic clitics to see whether the distribution of the L and H tone portion of the phrase accent follows the same patterns described in this paper.

Constraints on the location of phrase accent

When there is only one phrase accent (LHi) in the case of a default AP (i.e., when the AP contains one content word preceded by one or two clitics), the Hi occurs on the content word, closer to the beginning of AP. However, when the Hi tone occurs over a long sequence of clitics, its location varies from initial to antepenultimate to medial within the AP (Figures 8–9). That is, the realization of Hi on clitics is not always confined to the beginning of an AP (e.g., Figure 9b). (However, this is also true when an AP begins with three or four clitics and a Hi tone occurs on the content word. See Figure 7).

When there are two phrase accents over clitics, the first phrase accent occurs on the AP initial syllables, and the second phrase accent frequently occurs on the antepenultimate syllable of the AP (Figures 10, 11a). A similar distribution is found when there are two phrase accents over a long content word (more than six syllables). When there are three phrase accents over a long content word (e.g., Figure 5c, d), the location of the first and third phrase accent is the

same as when there are only two. The location of the second phrase accent is in the middle of the other two, thus producing a rhythmic tonal pattern with an alternation of L and H tones, but the actual location of 'middle' phrase accent varies across repetitions and speakers.

The rhythmic constraints we have found to condition the distribution of H tones are similar to those proposed by previous researchers (Verluyten 1984; Dell 1984; Martin 1986; Padeloup 1990; Delais-Roussarie 1995). That is, in French, sequences of three or four syllables without H tones are avoided, and H tones that are too close to one another are also avoided. The rhythmic principles mentioned in these studies are mostly based on metrical stress. However, the rhythmic principles governing the distribution of H tones in our model are based on the tonal alternation, i.e., they are tone-based rhythmic principles.

In addition to these tone-based rhythmic principles, the location of the phrase accent is also sensitive to morpheme boundaries. Thus, when more than one syllable is targeted for phrase accenting to satisfy the rhythmic principles, the phrase accent often occurs on the syllable nearest to the morpheme boundary. This suggests that the factors affecting the location of phrase accents are ranked, though the ranking is flexible. On the other hand, the preference for a phrase accent to occur around a morpheme boundary as well as the preference for the first phrase accent to occur on the content word (instead of the function word, when possible) supports the idea that intonational tone in French is not purely a phrase level property, but is sensitive to morphological information. This situation differs from Korean intonation in which the tonal pattern of an Accentual Phrase is not sensitive to any morphological information.

Finally, even though a long polymorphemic word tends to form one AP and a sequence of clitics form one AP together with the following content word, clitics or word internal syllables at a large morpheme boundary can carry a pitch accent (LH*) when the AP is too long or when the clitic is semantically important. This suggests that the distribution of the pitch accent is also governed by rhythmic principles and meaning groups. In addition to rhythmic and meaning constraints, the distribution of pitch accents is also influenced by contrastive focus. However, examples containing contrastive focus have not been treated here (see Footnote 2).

In this paper we presented different realizations of the French Accentual Phrase, and we proposed that the default tonal pattern of an AP is LHiLH*, with the initial rising tone, LHi, marking the beginning of a phrase and the final rising tone, LH*, marking the end of a phrase. This proposal is the same as that presented in the previous version of our model, but in the current version, we have categorized the initial rise a phrase accent whose tones are not associated with any specific syllable. We also categorized the final rise as a whole pitch accent (LH*), rather than considering it the H* of the final rise

as in our previous model. However, we determined that only the H* portion of the LH* pitch accent should be associated with the phrase final full syllable. For exceptional cases, such as when an AP is extra long due to several clitic syllables or word internal syllables, we found that an AP could have additional phrase accents whose appearance was constrained by rhythmic principles and morpho-semantic conditions.

We believe that, even though Accentual Phrases do not always surface with the default LHiLH* tonal pattern, our model is sufficiently constrained to avoid over-generating intonation patterns that are not observed, and yet it is also general enough to account for most surface realizations of the French AP. This is made possible by assuming the possibility of undershoot for tonal targets and phonetic implementation rules, as well as phonological constraints on the realization of the basic tones and sequences of tone types, and the rhythmic principles regulating tone distribution.

Acknowledgement

We wish to thank Mary Beckman, José Hualde, and Zsuzsanna Faygal for their valuable comments and encouragement, Melissa Epstein and Amanda Jones for proofreading and our speakers for their participation. The 2nd author is supported by grant 1114-059532 from the Fond National de Recherche Suisse.

*UCLA, Los Angeles
University of Geneva*

References

- Beckman, Mary and Janet Pierrehumbert (1986). Intonational structure in Japanese and English. *Phonology Yearbook* 3: 255–309.
- Delais-Roussarie, Elisabeth (1995). Pour une approche parallèle de la structure prosodique. Thèse de Doctorat, Université Toulouse le Mirail.
- (1999). “Accentuation et réalisation des clitiques en français”. *Cahiers de Grammaire* 24 ‘Phonologie : théories et variations’, 17–37.
- Delattre, Pierre (1939). Accent de mot et accent de groupe. *The French Review* 13: 2: 141–146.
- (1966). Les dix intonations de base du français. *The French Review* 40: 1–14.
- Dell, François (1984). L’accentuation dans les phrases en français. In François Dell, Daniel Hirst and Jean-Roger Vergnaud (eds) *La forme sonore du langage: la nature des représentations en phonologie*. Paris: Herman.
- Di Cristo, Albert and Michel Chafcouloff (1975). Contribution à l’étude des pronoms sujets en français contemporain. *Travaux de l’Institut de Phonétique d’Aix* 2, 101–137.
- Di Cristo, Albert and Daniel Hirst (1993). Rythme syllabique, rythme mélodique et représentation hiérarchique de la prosodie du français. *Travaux de l’Institut de Phonétique d’Aix*, 15: 9–24.
- Di Cristo, Albert (1999). Intonation in French. In Daniel Hirst and Albert Di Cristo (eds), *Intonation Systems: A Survey of Twenty Languages*. Cambridge: Cambridge University Press.

- Fonagy, Ivan (1979). L'accent en français : accent probabilitaire. In *L'accent en français contemporain*, Studia Phonetica, 15, Ivan Fonagy et Pierre Léon (eds.), 123–233. Paris: Didier.
- Fougeron, Cécile & Sun-Ah Jun (1998). Rate Effects on French Intonation: Phonetic Realization and Prosodic Organization. *Journal of Phonetics* 26 (1): 45–70.
- Garde, Paul (1968). *L'accent*. Paris: Presse Universitaire de France.
- Grammont, Maurice (1934). *Traité de Phonétique*. Paris: Delagrave.
- Hirst, Daniel and Albert Di Cristo (1996). Y a-t-il des unités tonales en français? *Actes des 2^{èmes} Journées d'Etude sur la Parole*, Avignon, 223–226.
- Jun, Sun-Ah (1996). *The Phonetics and Phonology of Korean Prosody: Intonational Phonology*. New York: Garland Publishing Inc.
- (1998). The Accentual Phrase in the Korean prosodic hierarchy. *Phonology* 15 (2): 189–226.
- (2000). K-ToBI (Korean ToBI) labelling conventions – Version 3. *The Korean Journal of Speech Science*, Vol. 7, No. 1: 143–169. [The same version is published in *University of California Los Angeles Working Papers in Phonetics* 99: 149–173].
- Jun, Sun-Ah and Cécile Fougeron (1995). The Accentual Phrase and the prosodic structure of French. *Proceedings 13th International Congress of Phonetic Sciences 2*, Kjell Elenius and Peter Branderud (eds.), 722–725, Stockholm, Sweden.
- (2000). A Phonological model of French intonation. In *Intonation: Analysis, Modeling and Technology*, Antonis Botinis (ed.), 209–242. Dordrecht: Kluwer Academic Publishers.
- Jun, Sun-Ah and Hyuck-Joon Lee (1998). Phonetic and phonological markers of contrastive focus in Korean. In *Proceedings of International Congress of Speech and Language Processing*, 1295–1298. Sidney, Australia.
- Ladd, D. Robert (1996). *Intonational Phonology*. Cambridge: Cambridge University Press.
- Lacheret-Dujour, Anne and Frédéric Beaugendre (1999). *La prosodie du français*. Paris: Centre National de la Recherche Scientifique.
- Lucci, Vincent (1983). *Etude phonétique du français contemporain à travers la variation situationnelle*. Grenoble: Publication Université de Grenoble.
- Marouzeau, Jules (1956). Accent de mot et accent de phrase. *Le Français Moderne* 24: 241–248.
- Martin, Philippe (1982). Phonetic realisation of prosodic contours in French. *Speech Communication* 1: 282–294.
- (1986). Structure prosodique et structure rythmique pour la synthèse. *Actes des 15^{èmes} Journées d'Etude sur la Parole* (Aix en Provence), Editeur: GALF, Groupe de la Communication Parlée, Lannion, France, 89–91.
- Martinet, André (1969). *Langue et fonction*. Paris: Denoël.
- Mertens, Piet (1987). L'intonation du Français. Doctorale Dissertatie, Katholieke Universiteit Leuven.
- (1993). Accentuation, intonation et morphosyntaxe, *Travaux de Linguistique* 26: 21–69.
- Milner, Jean-Claude and François Regnault (1987). *Dire le vers*. Paris: Seuil.
- Nespor, Marina and Irene Vogel (1986). *Prosodic Phonology*. Dordrecht: Foris.
- Pasdeloup, Valérie (1990). *Modèle de règles rythmiques du français appliquées à la synthèse de la parole*. Thèse de Doctorat, Université d'Aix en Provence.
- (1992). A prosodic model for French text-to-speech synthesis: a psycholinguistic approach. In *Talking Machines: Theories, Models and Designs*, Gérard Bailly, Christian Benoît and Thomas Sawallis (eds.), 335–348. Elsevier Science Publishers.
- Passy, Paul (1922). *Petite phonétique comparée des principales langues européennes*. Leipzig-Berlin: Tübner.
- Pierrehumbert, Janet (1980). The phonology and phonetics of English intonation. PhD. dissertation, Massachusetts Institute of Technology.
- (1993). Alignment and prosodic heads. In *The Proceedings of the Eastern States Conference on Linguistics* 10, Andreas Kathol and Michael Bernstein (eds.), 268–286. The Ohio State University.
- Pierrehumbert, Janet and Mary Beckman (1988). *Japanese Tone Structure*. Cambridge: MIT Press:

- Post, Brechtje (2000). Tonal and phrasal structures in French intonation. (Doctoral Dissertation, University of Nijmegen). The Hague: Holland Academic Graphics.
- Rossi, Mario (1979). Le français, langue sans accent? In *L'accent en français contemporain*, *Studia Phonetica* 15, I. Fonagy et P. Léon, 13–51. Didier: Paris.
- (1985). L'intonation et l'organisation de l'énoncé. *Phonetica* 42: 135–153.
- (1999) L'intonation, le système du français : description et modélisation. Paris: Ophrys.
- Selkirk, Elisabeth (1986). On derived domains in sentence phonology. *Phonology Yearbook* 3: 371–405.
- Ueyama, Motoko (1999). An experimental study of vowel duration in phrase-final contexts in Japanese. *University of California Los Angeles Working Papers in Phonetics* 97: 174–182.
- Vaissière, Jacqueline (1974). On French prosody. *Research Laboratory of Electronics Progress Report*, Massachusetts Institute of Technology 115: 212–223.
- (1992). Rhythm, accentuation and final lengthening in French. In *Music, Language, Speech and Brain*, Johan Sundberg, Lennart Nord, and Rolf Carlson (eds.), 108–120. Stockholm: Wenner-Gren.
- (1997). Langues, prosodies et syntaxe. *Revue Traitement Automatique des Langues, Association pour le Traitement Automatique des Langues* 38 (1): 53–82.
- Verluyten, Paul (1984). Phonetic reality of linguistic structures: the case of (secondary) stress in French. *Proceedings 10th International Congress of Phonetic Science*, Marcel P. R. Van den Broecke and Anthonie Cohen (eds.), 522–526.