Structural and Rhythmic Influences on the Occurrence of the Initial Accent in French

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ABSTRACT

Previous studies have proposed that, along with the final accent, the French phonological system includes an Initial Accent which has rhythmic functions. Descriptions of English prosody propose that an early accent marks Major Phonological Phrases. The present study investigates the structural and rhythmic functions of IA in French at various levels of phonological structure. Results on the occurrence of IA in materials that vary both in constituent length and depth indicate that IA is indeed a left boundary marker of phonological structure in French, and that both structural and rhythmic functions apply primarily at the level of the Minor Phrase.

1. INTRODUCTION

The main objective of this study was to expand our understanding of the phonological role of the Initial Accent in French. Although traditional descriptions of French phonology propose that French possesses only a phrase final accent characterized by a final lengthening [1] [2] [3], the Initial Accent (IA) has recently been integrated into a model of French accentuation [4]. Astésano [5] has shown that final accent coexist with IA, the latter contributing to accentual rhythmicity [6] [7]. IA is phonetically distinguishable from final accent: IA is characterized by significant lengthening of the onset element over the rime, and is marked by pitch alone, while final accent shows primarily lengthening of the rime [5].

Because Astésano's findings stemmed from continuous, uncontrolled speech in various speaking genres, the first aim of the research was to confirm the existence and nature of IA within linguistic materials controlled exactly for lexical and syntactic content. Also, although Astésano's findings offered good evidence for the role of IA as a marker of a phonological unit boundary, they did not identify the hierarchical position of the unit, which might be, for example, the Phonological Word (essentially equivalent to the Lexical Word) or a potentially larger unit such as the Major and Minor Phonological Phrase (see [8]). The literature on French accentuation describes only a rhythmic function, a tendency to periodic accentuation [6] [9] [4], but gives no systematic account as to where this initial accent occurs with regards to the syntactic structure or to traditional phonological units. Our first aim was thus to determine whether IA marks the Lexical/Phonological Word, or a larger phonological unit, such as Major and Minor Phonological Phrases which relate to syntactic constituency. An 'early' accent does seem to function as a syntactic marker in English: Shattuck-Hufnagel et al. [10] found that speakers place pitch accents at the beginning of Major/ Intermediate Intonational Phrases, often to avoid stress clash and mostly to mark Phrase Onset.

The present investigation thus proposes to test the possibility that French displays both the rhythmic effects often described for French and the kind of structural effects previously described only for English. We first asked whether speakers use IA to mark the onset of 3 levels of prosodic constituency, Major Phonological Phrase, Minor Phonological Phrase and/or Phonological/Lexical Word. If French IA behaves like English 'early accent', speakers will be more likely to place an IA at the onset of a Major/Intermediate intonational phrase than at the onset of a Phonological Word which is not at a phrase boundary. Any rhythmic tendency would enhance the structural attraction of these accents where the constituent was longer. The occurrence of IA is thus investigated both in relation to the length of constituents and their level in the prosodic hierarchy.

2. METHOD

2.1. Design

To test the tendency of initial accent (hereafter, IA) to mark the onset of a prosodic phrase, we constructed syntactically ambiguous Noun Phrases (NPs) similar to the 'Old men and women' example in English. For the equivalent French structure 'Les gants et les bas lisses' ('*the smooth gloves and stockings*'), the two possible readings are shown in Table 1.

In the narrow scope reading, the adjective LISSES applies only to the second NP (hereafter N2). In the broad scope reading, the adjective applies to the conjoined NP, that is, to both N1 (*gants*) and N2 (BAS). As in English, speakers can encourage syntactic disambiguation by introducing a phonological phrase boundary before N2 in narrow scope, while using no such phrase boundary when the adjective applies to the conjoined NP (N1 and N2) (see Table 1) [11]. In the latter case, a speaker can introduce a phrase boundary between N2 and the adjective (hereafter A). *In the absence of any context, broad scope readings are the default, whereas narrow scope requires a marked reading.*

To test the rhythmic function of IA, we varied the length in syllables of N1, N2 and A. Table 2 shows examples of N2 and A. By crossing scope and constituent lengths, we can determine whether the tendency towards use of IA is

controlled by Word length or Phrase length.

The original factorial design for the experiment includes 32 distinct conditions, all the possible combinations of

- Noun Length {1- 4 syllables}
- Adjective Length {1- 4 syllables}
- Syntactic Structure {broad v narrow scope of adjective}

Adjective Scope	Narrow		
Syntactic Structure	[[les gants et [les [BAS LISSES]]]		
Phonological Structure	Word	Word	Word
	Minor Phr.	Minor Phrase	
	Major Phr.	Major Phrase	
Adjective Scope	Broad		
Syntactic Structure	[[[les gants] et [les BAS]]] [LISSES]]		
Phonological Structure	Word	Word	Word
	Minor Phr.	Minor Phr.	Minor Phr.
	Major Phrase		Major Phr.

Table 1: Suggested mapping between the syntactic and phonological structures for French 'Old men and women' NPs. N2 and A target words are in small capitals.

The phonetic material was carefully controlled so as to avoid segmental variability and to limit contextual variation on Target Words N2 and A. Across the word-length variable, N2 words began wherever possible with the same first syllable and were followed by increasing numbers of syllables which were kept as similar on a segmental level as possible (*bas, balises, balivernes).* When this was not strictly possible, the segmental content was chosen to minimize any intrinsic duration variation. The same principle applied to A *(louches, loufoques, louvoyantes*). Furthermore, A's initial syllable at each N2 'word-length' was matched to N2's *final* syllable at the next (ex: *bas lisses, balises vertes, balivernes sottes* etc…) (see Table 2).

2.2. Materials

The target phrases were embedded in carrier sentences, controlled for number of syllables and syntactic construction. In each case, A was followed immediately by *en fait*, 'in fact', which forces a prosodic boundary. Four different sets of sentences were constructed, each allowing all levels of N2 length, A length and syntactic structure, yielding 64 sentences.

Nouns (N2)	Adjectives
Bas	lisses/ licites/ licencieux/ libérateurs
Balises	vertes/ vermeilles/ verticales/ vertigineuses
Balivernes	sottes/ saumâtres/ saugrenues/ somnambuliques
Baratineurs	fades/ fameux/ fabuleux/ fabulateurs

Table 2*: Phonetic material: e.g. 1 set of the 4 sets*

2.3. Speakers and procedure

Eight native speakers of French (four male and four female) served as informants. Speakers were instructed to read each sentence to deliver each of these meanings (*narrow scope: 'Les bas sont lisses, mais les gants ne sont pas lisses'* [the stockings are smooth, but the gloves are not] *vs. broad scope: 'Les gants et les bas sont lisses'* [both the gloves and the stockings are smooth]). All speakers read all sentences in both scopes 3 times. Materials were presented in a different random order for each speaker.

2.4. Experimental questions

Our experiment was designed to answer 3 questions.

1) Do speakers use IA to disambiguate syntactically between lexically identical sentences? If so, IA should be more common in N2 when A has narrow scope, and more common in A itself when it has broad scope.

2) Which level of phonological structure (Word, Minor or Major Phrase) is IA most likely to mark? Under the mapping in Table 1, and with 1 standing for IA and 0 standing for no IA, the following predictions are made: In broad Scope, Major Phrase control of IA would yield a '01' pattern (IA only on A). Word or Minor Phrase control of IA could produce a '11' pattern (IA on both N2 and A). In narrow scope, Word control of IA predicts the '11' pattern and Minor/Major Phrase control predicts a '10' pattern

3) Is IA also a rhythmic device, i.e. does its incidence rise with constituents length? This question must be viewed in the light of the domain of IA. If the Word is the domain of IA, then longer Words (for example A in narrow scope) should give a greater incidence of IA. If the Phrase is the domain of IA, then only longer Phrases more often start with IA (typically N2 + A in narrow scope).

3. RESULTS

3.1. Data exclusion

Two speakers were discarded after a judgment test with 6 naïve French listeners indicated that recognition of the intended meanings for these 2 speakers was just above chance level. Monosyllabic N2 and A were also discarded from the dataset because it is not possible to distinguish whether the presence of a F0 peak on monosyllables reflects the presence of an IA or a final accent. With these omissions, the data consisted of 1296.

3.2. Peak detection

The excerpts were digitized at 16 kHz and the fundamental frequency was modeled with a quadratic spline function using an automatic modeling algorithm [12] with manual corrections. The modeled F0 is represented by a sequence of target points <ms; Hz> corresponding to relevant local F0 variations.

To test whether a pitch accent was present on the first syllable of the target words N2 and A, we determined whether intonational Turning Points (i.e. F0 Peaks as in [13]) were associated with each target syllable. The onset and offset of the word N2 minus the last syllable was

labeled by hand. We excluded the last syllable of N2 in the 'word' segmentation so as to avoid any major F0 movement usually found on the last syllable of a word/phrase in French. This way, the presence or absence of an F0 peak could only be interpreted as reflecting a pitch accent at the beginning of the target words N2 and A.

An automatic detection of Turning Points was carried out on the entire corpus and checked manually on a subset.

3.3. Statistic analyses

The occurrence of stress patterns was subjected to binomial Sign tests by scope. The occurrence of IA on N2 and A was investigated using a separate by materials ANOVA. For N2, *Structure*, *N2 length*, and *A length* were repeated measures variables. For A, *Structure* and *A length* were repeated measures variables, N2 length was a grouping variable. The difference in ANOVA designs between N2 and A pertains to the fact that a different set of adjectives are associated with the same set of N2, at the different N2 lengths (see Table 2).

3.3.1. IA as a marker of the syntactic structure

If IA is a marker of syntactic structure boundaries, there should be more IA on N2 in narrow scope than in broad scope, and more IA on A in broad scope than in narrow scope. These predictions were met, with a larger proportion of IA on N2 in narrow (93.21%) than in broad scope (83%; $F(1, 71) = 18.27$; $p = .000059$) and on A in broad (52.31%) than in narrow scope (24.23%; $F(1, 213) = 110.46$; $p < .0001$).

3.3.2. IA as a marker of the phonological structure

Phonological structure effects were investigated by examining stress patterns over N2 and A. The 13.4 % of the data lacking IA on both critical constituents ('00' pattern) were not subject to analysis. Figure 1 shows their distribution in readings of each scope.

The prosodic domain of IA assignment was assessed by examining broad and narrow scope readings separately. In broad scope, if IA marks the Major Phrase, we would expect to see '01' patterns, since N2 forms a Major Phrase with N1 and A forms a separate Major Phrase. If IA marks either the Minor Phrase or the Word, we would expect to see '11' patterns, since both N2 and A are separate Minor Phrases as well as separate Words. In broad scope, '11' patterns occurred significantly more often than '01' patterns (42.9 % v. 9.41 %, Sign test at $p < .0001$), suggesting that IA operates either at the level of the Minor Phrase or at the level of the Word.

In narrow scope, if IA marks the Major Phrase or the Minor Phrase, we would expect to find primarily '10' patterns, since A forms both Major and Minor Phrases with N2; if IA marks the Word, we would expect '11' patterns to be found, since both N2 and A are separate Words. Because '10' patterns occurred significantly more often than '11' patterns (69.9 % v. 23.3 %, Sign test at $p < .0001$), we can reject the Word as the domain of IA occurrence.

Taken together with results from broad scope, these results

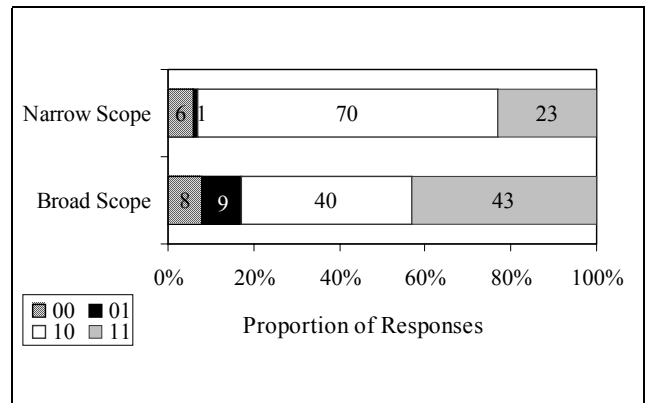suggest that the domain of IA occurrence is the Minor Phrase.

Figure 1: Distribution of stress patterns in narrow and broad scopes: 1 = IA, 0 = no IA.

3.3.3. IA as a rhythmic device

If IA serves a rhythmic function, we expect to see an effect of Phrase length on the occurrence of IA. This means that in broad scope, we expect an effect of N2 length on IA occurrence on N2, and an effect of Adjective length on IA occurrence on A, since both are at Phrase boundaries. In narrow scope, where N2 + A together are expected to form a single Phrase, we might expect a greater number of IAs on N2 as Phrase (N2 + A) length increases. Figure 2 presents the main effects of constituent length in both scope conditions.
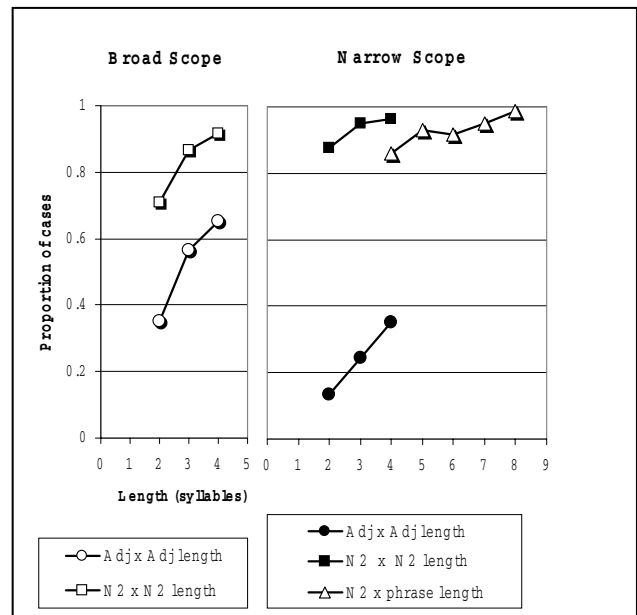

Figure 2: Effects of constituent length (syllables) by scope on IA occurrence. Hollow shapes indicate a relationship to Phrase length. Filled shapes show effect of Word length.

In broad scope, both longer N2s and longer As contain more IAs (N2 length: $F(2, 142) = 27.26$, $p < .0001$; LSD within scope x N2 length at $p < .0001$; A length: $F(2, 426) = 45.85$, $p < .0001$; LSD at $p < .0001$; A length x scope, *n.s.*). In narrow scope as Figure 2 shows, the effect of

Phrase length on IA in N2 is less obvious but still significant (Adjusted R^2 = .015; $F(1, 646)$ = 10.79; p = .00107). One reason for this effect can be seen in the Word length effects in narrow scope (filled shapes). Although N2 + A should form a Phrase, speakers may choose to break the syntactic unit into two Phonological Phrases each potentially with its own IA. The increased incidence of IA in A as they get longer (filled circles: F for A length as given above) suggest that these additional phrases are being made. In fact, the incidence of '10' patterns falls (Adjusted R^2 = .04; $F(1, 646)$ = 28.64; p <.0001) and of '11' patterns rises (Adjusted R^2 = .05; $F(1, 646)$ = 35.43; p < .0001) as A lengthens. In effect, longer A may have been promoted to Minor Phrase.

Taken together, these results suggest a rhythmic function of the IA in addition to its function as a boundary marker.

4. CONCLUSION

This study was designed to investigate the functions of IA in French as a (left) boundary marker and as a rhythmic device. Its results indicate that IA is indeed a marker of the phonological structure because it can be made to appear in an ambiguous word string when we force an interpretation which locates it at a syntactic boundary. However, although English 'early' accent is predominantly found at Major/Intermediate Intonational boundaries [10], our results suggest that the similar tendency to mark the beginning of constituents applies to the domain of the Minor Phrase in French.

Taken together, our results thus suggest that IA in French serves both a structural and a rhythmic function, and that IA's domain of occurrence is the Minor Phrase.

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REFERENCES

[1] L.M. Hyman, *Studies in stress and accent*, L. Hyman (ed.), Southern California Papers in Linguistics, 1977.

[2] M. Halle and J.R. Vergnaud, *An Essay On Stress*, Cambridge, MA: MIT Press, 1987.

[3] J. Fletcher, 'Rhythm and final lengthening in French', *Journal of Phonetics*, 19 (20, pp. 193-21, 1991.

[4] A. Di Cristo, 'Le cadre accentuel du français: essai de modélisation', *Langues*, 2001.

[5] C. Astésano, *Rythme et accentuation en français. Invariance et variabilité stylistique.* Paris : Editions L'Harmattan, Collection Langue et Parole, 2001.

[6] I. Fónagy, 'L'accent en français: accent probabilitaire' In *L'accent en français contemporain (Studia Phonetica)*, I. Fónagy & P. Léon (eds.), 15, pp. 123-233, 1980.

[7] G. Fant, A. Kruckenberg and L. Nord, 'Language specific patterns of prosodic and segmental structures in Swedish, French and English', *Proceedings of the XIIth ICPhS*, 4, Aix-en-Provence, pp. 118-121, 1991.

[8] E. Selkirk, 'On Prosodic Structure and its Relation to Syntactic Structure', *Nordic Prosody*, Vol. 2, T. Fretheim (ed.), pp. 111-140, 1980.

[9] M. Rossi, 'L'intonation et l'organisation de l'énoncé' *Phonetica*, 42, pp. 135-153, 1985.

[10] S. Shattuck-Hufnagel, M. Ostendorf and K. Ross, 'Stress shift and early pitch accent placement in lexical items in American English', *Journal of Phonetics*, 22, pp. 357-388, 1994.

[11] P.J. Price, M. Ostendorf, S. Shattuck-Hufnagel and C. Fong, 'The use of prosody in syntactic disambiguation', *Journal of the Acoustical Society of America*, 90 (6), pp. 2956-2970, 1991.

[12] D. J. Hirst and R. Espesser, 'Automatic modelling of fundamental frequency with a quadratic spline function', *Travaux de l'Institut de Phonétique d'Aix*, 15, pp. 71-85, 1993.

[13] D.R. Ladd, *Intonational Phonology*, Cambridge Studies in Linguistics: Cambridge University Press, 1996.