10
Rhythm, accentuation and final lengthening in French

J. Vaissière

INTRODUCTION:

Following tradition and for the sake of convenience in contrasting French with other languages, much of the research and theory have assumed that French has a stress located on the last full syllable of every lexical word, an "accent de mot intrinsèque" (Rousselot, 1924). Lexical words are opposed to function words, such as articles and auxiliaries, which do not have a potentially stressable final syllable (Garde, 1968). In continuous speech, the "accent de mot" or word accent of a number of lexical words is often not fully realized, or not realized at all, due to modifications dictated by the larger patterns of the speech measure or phrase (a phenomenon not particular to French, Heffner, 1950:228). Only the last syllable of the last word in a group of words, lengthened and often superimposed with a fundamental frequency (Fo) rise or a Fo peak as the expression of continuation, is regularly perceived as prominent, giving rise to the so-called "accent de groupe" (Delattre, 1966:75). There is no clear cut definition of this "groupe". A group generally constitutes a unit of meaning, a sense-group. The same sentence can be chunked into more or less units of meaning, depending on the rate of speaking and on the speaker (Grammont, 1914; Coustenoble and Armstrong, 1934; Delattre, 1966:65; Vaissière, 1974:216; Vaissière, 1989; see also Hirst & Di Cristo, 1984). Prominence can be perceived also at the beginning of the word, as a consequence of emphasis (Grammont, 1914), of the "accent intellectuel" (Marouzeau, 1934; Roudet, 1910), as a regular characteristic of professional announcers (Léon, 1971; Fonagy & Fonagy, 1976), and in certain dialects (Fouché, 1936; Carton, 1976). I have shown that a word initial Fo rise exists at the onset of lexical words, in non emphatic reading of professional (Vaissière, 1971) and non professional speakers (Vaissière, 1974, 1975; Mertens, 1987; see a review by Fonagy, 1980), the relative amplitude of which is speaker dependent.

What about rhythm in spoken French? Rhythmic organization is inherent to all human activity (Lashley, 1951), and the observed rhythms produced and perceived in

in "Music, Language, Speech and Brain", edited Sundberg, J., Nord, L., Carlson R, Wenner gre Intern. Symposium Serie, Vol 59, 108-120

spoken language are closely related to rhythms of other human behavior (see for discussion, Allen, 1975). The study of rhythm in speech is "a difficult business" (Heffner, 1950: 201). The basic principle of rhythm is probably independent of the language spoken, and rhythm is based on the perception of repeated patterns composed of successive events. It is related to the notion of periodicity and to structure (Fraisse, 1956). It is reasonable to assume that the components of rhythm are not bounded exclusively to a single percept, such as the stress or the syllable (cf the proposition of Pike, 1945, of English as a stress-timed language with isochronous feet, and French as a syllable-timed language with isochronous syllables; Abercrombie, 1967; see Dauer, 1983 and Scott & al, 1985, Wenk & Wioland, 1982, for discussions). The repetition of events of different nature (such as a certain sound) can create rhythm (Bally, 1926:255). Moreover the perception of rhythm in a specific language seems to depend on the degree of command of that language by the listeners and on their internalized knowledge of the language structure. Rhythm is not only a matter of acoustic measurements. The rhythm in French seems very obvious to me (as a native of French), much more obvious than the rhythm in English, where the stream of units of information is thrown into disorder by the intrusion of a recurring strong stress. To a certain extent, stress is felt as an unnecessary addendum to spoken English, as compared to written English. The language-specific rules of French may indeed not be obvious to non natives. Heffner notes that "languages with strong stress are likely to have rhythms of no subtlety whatever; languages which make less use of stress contrast have rhythms which are less obvious. The rhythms of English and French, for example, are in many ways comparable to the rhythms of Sousa and Debussy" (Heffner, 1950: 227). As a first order approximation, native listeners of English seem to equate rhythm with accentuation and recurrence of stress. Since there is no obvious stress in French, such listeners may have trouble to grasp a rhythmical organisation.

It may be interesting to investigate further the reasons underlying the reciprocal difficulty in perceiving and reproducing the two kinds of rhythm, English and French, and the intrusion of an English-like rhythm in French. The content of the present paper is also largely inspired by the work of Fraisse. Fraisse is a French psychoacoustician who has devoted all his life to the problem of rhythm (in particular, Fraisse, 1956, *Les structures rythmiques*). His distinction between two basic rhythms, "rythmitisation intensive" and "rythmitisation temporelle" from experiments on non speech stimuli seems to shed some light on the possible alternative rhythmic patterns applicable to languages.

The purpose of this paper is threefold: (i) to review the regularities in the prosody of French, which are the bases for rhythm; (ii) to summarize the results of some psychoacoustic experiments, relevant for the interpretation of the different rhythms; (iii) to ask whether or not the rhythmic principles of standard, traditional French are undergoing a progressive change.

1: ACOUSTIC CHARACTERISTICS OF THE THREE RHYTHMIC UNITS IN MODERN FRENCH

There seem to exist three perceptual units from longest to shortest, the repetition of which give rise to a multilayered rhythm: (i) the repetition and alternation between two basic global tunes, spanning over the breath-groups, (ii) the repetition of variants of an archetypal prosodic word (PW) pattern; (iii) the succession of typically open syllables CV, with a dominating vowel.

It has to be noted that one level may be made more emergent than the others. The regular succession of the smallest rhythmic units, the syllables, can prevail in carefully spoken, slow speech. The recurrence of more or less regular PWs and rhythmic groups composed of 3 or 4 syllables, may be put forward in poetry. In rapid, conversational speech, the listeners may directly perceive the repetition of typical breath-groups.

It is difficult to disentangle the different units in a purely acoustic study. However the striking regularities observed in durational and Fo patterning seem to correlate rather well with the perceived quality of French rhythm. The following description is an oversimplification of the observed facts. The oversimplification is not only due to a lack of space. According to the Gestalt principle of Pregnänz, percepts always tend toward "as good a figure" as the stimuli objects permit, to become archetypal, prototypical. The following caricatural patterns (and the corresponding figures) seems to correspond to a psychological reality.

1.1: THE BREATH GROUPS PATTERNS

The first basic ingredient of French rhythm is the alternation of two highly contrastive, rising and falling global pitch contours at the level of the breath group, BG. There are generally pauses between two BGs, not necessarily accompanied by breathing, and they may not be even present in the acoustic signal. The two global patterns resemble the two well-known Tune 2 and Tune 1 described for English (Armstrong & Ward, 1926; Jones, 1909), and the marked and unmarked breath-groups of Lieberman, 1967 (see Figure 1, top). There is some tendency to make the BGs equally long, since the speakers tend to put pauses at regular intervals (Grosjean, Grosjean, & Lane, 1979). A text or a discourse appears first as a succession of such patterns.

The two BGs have in common a rise of Fo near their beginning (Ri) in Fig. 1, top), on the first syllable(s), and their final syllable is lengthened (a characteristic which exists in different languages, see Vaissière, 1982 for references).

BG+ is characterized by a final sharp continuation rise on the last full syllable (Rc in Fig. 1), preceded by a low Fo value (L in Fig. 1) on one of the preceding syllables. BG- is characterized by a large Fo fall (FF), starting from the end of the penultimate word (in Fig. 1) and ending by a very low Fo value on the last syllable (VL).

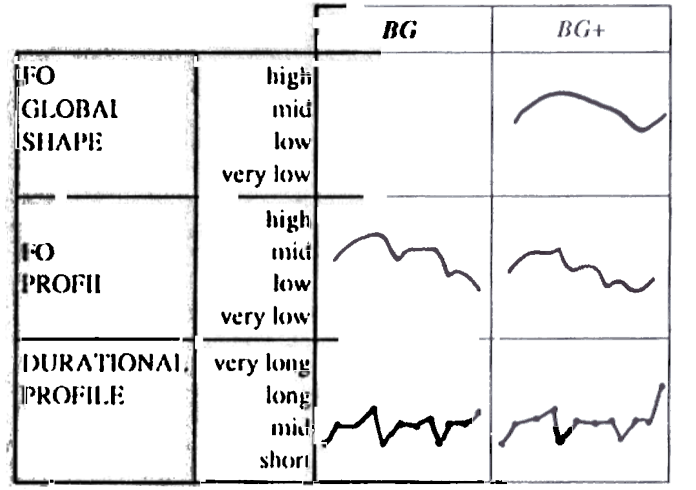


Figure 1: The archetypal breath groups and their decomposition into three prosodic words by Fo fluctuations and duration contrasts: the valleys correspond to the function words, and the peaks to the final syllables of lexical word. The curve correspond to BGs composed by three 3-syllabic lexical words preceded by a monosyllabic function word.

The contrast between BG+ and BG- seems largely "exaggerated" in French, as compared to English (Delattre, 1966:75). The initial rise, the final fall and the continuation span their effect over several syllables, whereas in American English, most of the Fo changes occur within a single stressed syllable and most of the BG+ end with a falling intonation followed by a small rising hook, and very few by a clear rising intonation (10% according to Pike, 1945: 1554).

1.2: THE PROSODIC WORD PATTERNS

Long BGs are prosodically substructured by an oscillation of the pitch between the high register and the low register and by durational contrasts (See Figure 1, bottom). The rise and the fall tend to succeed in a rather regular manner (Vaissière, 1974, 1975, 1982). The combination of a successive rise and fall and a durational peak roughly corresponds to a PW, in French as well as in other languages (see Vaissière, 1983 for references, discussions and examples). The correspondence between the rises and the falls and the characteristics of the words depends on the language. In French, the rises and falls are directly related to the word boundaries, as established by the tradition, and not to stressed syllables, like in English.

The very basic principles of alternation are the following. First, lexical words contrast with function words by pitch: they tend to be uttered on the high register and the function words on the low register (for detailed rules, see Vaissière, 1974, 1975). Second, there is a strong durational local contrast between the final syllable of a lexical word which represents a local peak of duration, and the following short function word (a valley in durational profile). As a consequence, the most typical boundary in traditional French is acoustically marked by a change from high to low register accompanied by an local acceleration of tempo.

The repetition of the same PW and of the same boundary markers increases the sensation of rhythm at the level of the BG. The successive PWs may however differ by their global shape and their final pitch.

The decomposition of the BG into PWs and the choice of the variant for the PW follow some general principles:

1) long lexical word (consisting of 3 syllables or more) often corresponds to a single PW. Semantically related short words, such as a noun followed by an adjective, tend to be regrouped into a single PW, and this can be attributed to a tendency toward uniform size of the PWs in terms of number of syllables.
2) the detailed Fo pattern of each PW depends on its length and on the glide associated with its final syllable, which can be rising, flat or falling. The initial rise at the word beginning is extended to the following vowel and syllable depending on the strength of the underlying segments (see examples in Vaissière, 1974:253; for a measurement of the strength of the phonemes, Delattre, 1966:112). There is a feature hierarchy for the realisation of the PW and the tune on the final syllable is given priority over word initial rise (Vaissière, 1974, 1975, 1983).
3) the choice of the glide on the final syllable depends on two factors. First, the degree of dependency of the word with the following word: a peak pattern, with rising glide expresses independence (corresponding to the "continuation" of Delattre), while the falling pattern expresses dependency. Second, each individual speaker tends to repeat the same pattern (Vaissière, 1974:256). In other words, the strength of the boundaries is syntax dependent and speaker variable.

As shown in Fig. 1, the melodic and duration profiles tend to be basically rising, from short and low (corresponding to a function word at the rhythmic group beginning) to high and long syllables (corresponding to lexical word final syllables; see also Delattre, 1966; Touati, 1987), with a plateau on the intermediate syllable(s) (corresponding to the lexical word non final syllables).

Such an increasing durational pattern is disturbed by the following conflicting influences:

1) a short-long alternation, starting backwards with the last syllable as long (Duez & Nishinuma, 1984).
2) a slight tendency of the word initial consonant to be lengthened, particular in the case of unvoiced stop consonants.
3) a tendency for the heavier syllables (closed syllables and syllables with nasal vowels) and end of morphemes (in verbs) to represent local peaks of duration.
4) a relative lengthening of the penultimate syllable, which may be perceived as a mark of regional accent (Carton, 1967).
5) the intrinsic and cointrinsic influences on the duration of each segment (see Di Cristo & Hirst, 1986).

The tendency to alternation seems to be "an exaggerated" feature in English, and has given rise to important theoretical developments in the metrical theory (Liberman and Prince, 1977, among others). In French, the word initial rise bounded to the onset of PW of more than two syllables (Vaissière, 1971, 1974) seems of greater importance than the alternation principle.

In terms of size, the PW probably corresponds to the stress group level in English. Isochrony between stresses in English which is known to be essentially a perceptual phenomenon with a psychological reality (Lea, 1974, Lehiste, 1977) probably corresponds to the tendency for the rise and fall composing the PW to succeed evently (See the work by Fant and coworkers, 1990 and forthcoming, showing a similar tendency in English, Swedish and French to make prominence crop up at regular intervals, around 550 ms). The lack of one clearly prominent syllable in the PW makes it less perceptually salient than the stress group, where the stressed syllable constitutes an anchor point. What seems salient to me in French is the boundary marking between the successive PWs. The smaller saliency of the PW in French gives more room for the lower unit, the syllable, to play a dominant role in perception.

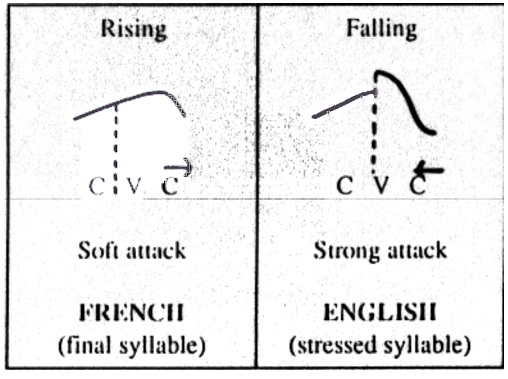


Figure 3: The archetypal syllable: the curves pertain to the general impression of the evolution of tension, and the shape are also typical of the Fo glide during the final syllables in French and the stressed syllables in English.

1.3: THE ARCHETYPAL SYLLABI IN FRENCH AND ITS VOCAL QUALITY

Among the major linguistic factors which contribute to the subjective impression a listener experiences concerning rhythm, one is certainly related to "le mode tendu" and "le mode croissant" (Delattre, 1966:9), and the related characteristics such as the soft attack of the vowels, and the basic CV syllable (see Figure 2 for a very impressionistic sketch).

a) **Le mode tendu:** Phonation is perceived as particularly tense. There are no affricates, no lax vowels, not much reduction, no diphthongs and no diphthongized vowels (Delattre, 1966: 323), and the vowels are often considered as close to the cardinal vowels as defined by Jones. Intensity tends to stay constant, despite eventual changes in Fo and duration. The quantum of muscular energy which goes into each syllable seems equal, at least in non emphatic speech.

b) **Le mode croissant:** French syllables seem predominantly rising, with the vocal tract opening progressively up to the very end of the syllable, which typically ends with a vowel. The consequences are delayed Fo peak and intensity peak (Delattre, 1966:151). There is a strong anticipatory coarticulation effect during the consonant preceding each vowel (Delattre, 1966:122), contributing to a softer attack (onset) of the vowel, as compared to English. Inside a PW, the syllable-final consonant tends to link with a following vowel, increasing the number of open syllables.

c) The number of **open syllables** prevails in French (76% according to Delattre, 1965:42, and most of the syllables have the simple structure CV (54.9%; the most common type in English is CVC, 31.8%). According to statistics on the phonemes, the typical phonic impression left by French would be a dental with strong front resonance (Delattre, 1965:61). In English, the greater length, larger complexity and the larger variety of the syllables (60% close syllables and 40% open syllables) make the syllable a less clear psychological reality than in French, according to the laws of the Gestalt Theory on "pregnant" forms.

Such subtle differences in syllable articulation are difficult to quantify. Nevertheless they might be very important perceptual features. Note that there is a certain similarity between the CV syllable rising stereotype for French syllables and the basic rising stereotype for French disyllabic words as proposed by Grammont for intensity (Grammont, 1914), pitch and duration Delattre (1965:23), on one side, and the two falling stereotypes with strong vocalic onset for the English syllable and the falling Fo pattern on English disyllabic words with primary stress on initial syllable. As noted by Delattre (1966:25), French gives a rising impression, and English a falling one.

The pregnant speech pattern stored in speakers' memories influences the way they perceive the different languages (See Delattre's examples, 1965:23). Psychoacoustic results seem to reveal that French and English archetypal patterns, apparently very different, may be two variants of the realisation of a universal pattern.

2: PSYCHOACOUSTIC EXPERIMENTS

As stated in the introduction, rhythmic effects derive from universal organizing principles of human perceptual and motor behavior.

One of the main conclusions drawn from psychoacoustic experiments is that grouping is a fundamental characteristics of perception (Fraisse, 1974:74). Sequences of equally spaced, identical tone bursts appear to be regrouped into units of 2, 3 or 4 and perceived as rhythmic (Woodroow, 1951: Fraisse, 1974:82). This may explain the relatively short size of the stress group in English and of the PW in French. The speed of succession of the bursts influences the preferred size of the grouping: the more rapid the succession, the greater the number of elements in the group (Bolton, 1894, cited by Fraisse, 1956). Experiments with click location in speech suggest that listeners do not deal with each sound separately but rather with a group of sounds (Ladefoged & Broadbent, 1960; Fodor & Bever, 1965).

Once subjectively regrouped, the first burst of the group is perceived as **accented**, the last interval, which becomes the interval boundary, is perceived as **longer**. One of the two phenomena (initial accentuation or final lengthening) may receive perceptual dominance. In English and French, initial accentuation and final lengthening seem to dominate, respectively. If English is to be considered mainly as a *"stress language"*, then French should be considered mainly as a *"boundary language"*. Lengthening is also used in English as a boundary marker (Lehiste & al, 1976). Initial accentuation in French is realized by the word initial rise in non emphatic reading, and it becomes perceptually dominant in emphatic speech. But what is generally prevailing is the perception of stressed syllables in English, and of boundary between words in French.

Psychoacoustic experiments on tone burst have largely confirmed the role of a longer interval or of a elongation of a pulse as a left boundary marker, the role of accentuation (by increase intensity or pitch) as a left boundary marker, and the tendency to perceive as isochronous the elements inside a grouping (Woodrow, 1951; Fraisse, 1956 and 1974 for a summary and references and Allen, 1975). An Fo jump on the first syllable after a strong attack is perceived as an increase in intensity, but not as a jump in pitch (Séguinot, 1976).

If a pulse is made longer that the final pulse, regrouping occurs, and the longest element becomes the final element. This may explain why word initial pitch jump in French is done without increasing much the duration of the underlying initial element (Fo jump and lengthening tend to be associated in English), and why duration is less and less used distinctively for differentiating the vowels.

Not all speakers, however, react in the same way when presented with the same stimuli. When some elements are more intense, the majority of listeners perceive the boundary before the accented burst ("rythmitisation intensive", according to Fraisse,

1956). One third perceive the accented burst as group final. The last category of listeners seem to overestimate the interval after the accented burst, and interpret the lengthening as a left boundary ("organisation temporelle"). Both rhythms may coexist in the same speech material, and their coexistence makes it more difficult to perceive rhythmically. The inherent ambiguity between accentuation and induced lengthening may explain why French seems to avoid a strong accentuation of final syllables, and overlengthening of one syllable in the group, except the final one, which can be lengthened almost at will, but also very little. If too accented, the final syllable may be perceived as group initial. If one syllable becomes longer than the final syllable, it may be perceived as group final. It also explains why emphatic stress in French falls on the word initial syllable: strong accentuation is psychologically more compatible with word beginning than word ending. It should be also noted that stress languages (like English, German and Spanish, see Delattre statistics, 1965:31; Cutler and Carter, 1987) have very few syllables with final stress. In other words, accentuation and final position are less compatible than accentuation and initial syllables (see work on final lengthening as boundary marker in English by Klatt, 1976, Cutler and Butterfield, 1989, and Butterfield & Cutler, 1988, on segmentation errors in English due to the insertion of a boundary before a strong syllable). Demany & al (1977) found a precocious achievement of organisation in temporal form in pre-verbal infants. Temporal organization seems to appear earlier in child development than intensive "rhythmization". English children polysyllabic utterances sound typically syllable-timed (Allen & Hakwins, 1978). Final lengthening appears in the speech of French children at the age of 24 months (Konopzynski, 1988; see also, Oller & Smith, 1977). All these phenomena are coherent with the idea of a superposition of two related basic rhythms, as described by Fraisse. Modern French seems to be an example of the confusion created when the two rhythms coexist.

3: THE TWO RHYTHMS IN MODERN FRENCH

Prominence on final syllables was generally considered to be the rule in non emphatic French. There is however a long series of papers starting in the previous century which question this traditional point of view (see Fonagy, 1980, for a review). Some phoneticians considered as 'désagréable', 'vulgaire' or as a pronunciation error the displacement of the prominence to the beginning of a word. Many phoneticians simply ignore the fact. Many books mention that "correct French" should avoid to put some syllables more prominent than others. The description of a regular initial rise at PW onset in texts read by non professional readers without regional accent (Vaissière, 1974, 1975) was a sort of surprise. Most of my colleagues interpret the occurrence of the initial rise as an expression of emphasis, or journalistic style, and continue to ignore the fact in their description of standard (non emphatic) French prosody. The frequent prominence of the word initial syllable was however noticed by Fonagy, mainly in perceptual experiments.

In their paper, "Prosodie professionnelle and changements phonétiques" (Fonagy & Fonagy, 1976), the authors compare the position of perceived prominence relative to the word boundaries in different styles. In a very small number of cases (less than 4%), a word is perceived with both initial and final prominence. In about one case out of five, prominence is perceived on two successive syllables. In most of the cases, following the traditional point of view, prominence is perceived on the final syllable: 75% for conversational speech, 72% in story telling, and 64% in TV news-reading (page 202). Two degrees of prominence were distinguished. While in conversational speech and story telling, final syllables were perceived as more prominent than initial syllables (oxytone scheme), in journalistic style, initial syllables were perceived as more prominent in 74% of the cases (barytone scheme), with the apparition of a number of glottal stops characterising word initial vowels (207). The authors note a certain analogy between the styles of the French and English radio announcers (215). They conclude that initial accentuation which is considered as expressive (emphatic stress) in non professional speech, becomes a regular characteristic of the style of radio announcers. The distribution of prominence is much less regular in news reading than in the two other modes (200) and the most frequent spacing between two prominences is speaker dependent. While in conversational speech and story telling, the function words are generally not perceived as prominent, in journalistic style, a prominence can be perceived on the very first element of the rhythmic group, a function word (203). The probability for a function to be accented is 0.03 in story telling, but 0.42 in news reading (Fonagy, 1980: 160). The probability of a word initial prominence depends on the speakers (for political speeches, see Duez, 1978: 79). French listeners are not consistent in detecting prominence, and it is a difficult task for them (Fonagy, 1980 130). For Fonagy, the present-day French prosodic system is in the process of a change the variability may be the expression of this on-going change.

CONCLUSION

This contribution has been based on the investigation of the particularity of French rhythm. Oversimplified patterns at three different levels, the breath group, the prosodic word and the syllable are proposed as reference patterns. The first layer, the breath group layer consists in the repetition and alternation between two highly contrastive global tunes, which resemble Jones' Tune 1 and Tune 2, but the difference between which is extremely exaggerated in French. The second layer concerns the repetition of variants of an archetypal prosodic (PW) word pattern, shaped by the successive oscillation of the pitch between the high and the low register: the striking fact is that in French the up and down of pitch oscillation are bounded to boundaries. Both duration and pitch seem typically to increase from the beginning to the end of the rhythmic group. The last layer is the succession of typically open syllables with a simple CV structure, characterized by their tenseness and rising mode. Large references to Delattre's work are made.

Both the prosodic word in French and the tone group in English are interpreted as two variants of the same archetypal psychological pattern which associated accentuation with the beginning and lengthening with the end. Fraisse' work on the possibility of differently regrouping the same stimuli depending an "intensive" or "temporal" "rhythmization" are exploited to explain both the differences between French and English basic rhythm at the level of the PW (for French) and the tone group (for English) and the intrinsic ambiguity of the present-day rhythm in French. The tone group in English is interpreted as a variant of the archetypal pattern where accentuation is dominant, and lengthening recessive. In the French PW, temporal organisation is predominant, but initial accentuation is also intrinsically present (emphatic stress and initial rise) leading to some confusion in the present-day scheme of French prosody. If English is to be interpreted as a "*stress language*", French should be called a "*boundary language*", because boundary is much more psychologically real than stress for French (at least, for me!). It would be interesting to investigate how basic psychological constraints are integrated into the prosody and rhythm of other languages.

Acknowledgement: *I thank very much Danielle Duez for her help and fruitful discussions on Fraisse' work during the preparation of this paper. I am also grateful to Daniel Hirst for a friendly help with the final version of this paper. This paper was mainly prepared while the author was an Associate Professor at the Institute of Phonetics of Aix-en-Provence*

REFERENCES

Abercrombie, D., (1967), ELEMENTS OF GENERAL PHONETICS, Edinburgh, Edinburgh University Press.
Allen, G., & Hakwins, S., (1978), "The development of phonological rhythm", in SYLLABLES AND SEGMENTS, A. Bell, J. Hopper, (eds), Amsterdam: North Holland Publishing C°, 173-188.
Allen, G.D., (1975), "Speech rhythm: its relation to performance universals and articulatory timing", *J. Phon.*, 3, 75-86.
Armstrong, L.E. & Ward, I.C., (1926), A HANDBOOK OF ENGLISH INTONATION, Cambridge.
Bally, C., (1926), "Le rythme linguistique et sa signification sociale", 1er Congrès du Rythme, Genève, 253-265.
Bolton,, T.L., (1894), "Rhythm", *Amer. J. Psychol.*, 6, 145-238.
Butterfield, S. & Cutler, A, (1988), "Segmentation errors by human listeners: evidence for a prosodic segmentation strategy", Proceedings. of Speech' 88., Edinburgh, Vol. 3, 827-833.
Carton, F., (1967), "Pente et rupture mélodique en français régional du Nord", *VI Int. Cong. Phon. Sc.*, 237-241.
Carton, F., (1976), "Insistance dialectale", *Studia Phonetica*, 12, 60-92.
Coustenoble, H.N., & Armstrong, L.E., (1934), STUDIES IN FRENCH INTONATION, W. Heffner and Sons Ltd, Cambridge, England..
Cutler, A., & Butterfield, S., (1989), "Natural speech cues to word segmentation under difficult listening conditions", *Eurospeech 89*, European Conference on Speech Communication and Technology, Paris, Vol. 2, 372-375.
Dauer, R.M., (1983), "Stress-timing and syllabe-timing reanalyzed?", *J. Phon.*, 51-62.
Delattre, P., (1965), COMPARING THE PHONETIC FEATURES OF ENGLISH, GERMAN, SPANISH AND FRENCH, Julius Gross Verlag.
Delattre, P., (1966), STUDIES IN FRENCH AND COMPARATIVE PHONETICS, Selected papers in French and in English, Mouton, London, The Hague, Paris.
Demany, L., MCKenzie, B., & Vurpillot, E. (1977), "Rhythm perception in early infancy", *Nature*, 266, 5066, 7, 118-9.
Di Cristo, A., & Hirst, D., (1986), "French micromelody: analysis and synthesis", *Phonetica*, 43, 11-30.
Duez, D, & Nishinuma, Y., (1984), "Some evidence of rhythmic patterns of spoken French", PERILUS, 1984-5, 30-40.
Duez, D., (1978), ESSAI SUR LA PROSODIE DU DISCOURS POLITIQUE, Thèse de 3ième Cycle, Univ. de Paris III.
Duez, D., (1987), CONTRIBUTION A L'ETUDE DE LA STRUCTURATION TEMPORELLE DE LA PAROLE EN FRANCAIS", Thèse d'Etat, Université de Provence.
Fant, G., Kruckenberg, A., & Nord, L., (1990), "Segmental durations within a prosodic frame in Swedish, French and English", PHONUM 1, Reports from the Department de Phonetics, University of Umeå, Sweden, 42-45.
Fant, G., Kruckenberg, A., Nord, L., (forthcoming), "Duration correlates of stress in Swedish, French and English", in Proceedings of the Second Seminar on Speech Production, Leeds, May 1990, To appear in *J. Phon.*
Fodor, J.J., & Bever, T., (1965), "The psychological reality of linguistics segments", *J. Verb. Learn. Behavior.*, 4, 414-420.
Fonagy, I, & Fonagy, J., (1976), "Prosodie professionnelle et changements prosodiques", Le français moderne, 44, 193-228.
Fonagy, I., (1980a), "L'accent français: accent probabilitaire (dynamique d'un changement prosodique", in L'ACCENT EN FRANCAIS CONTEMPORAIN, *Studia Phonetica* 15, Fonagy, I. & Léon, P. (Eds.).
Fouché, P., (1936), "Les diverses sortes de français Au point de vue phonétique", *Le Français Moderne*, 4.
Fraisse, P., (1956), LES STRUCTURES RHYTMIQUES, Louvain, Publications Universitaires.
Fraisse, P., (1974), PSYCHOLOGIE DU RYTHME, Collection SUP, Presses Universitaires de France.
Grammont, G., (1914), TRAITE PRATIQUE DE PRONONCIATION FRANCAISE, Paris.
Grosjean, F., Grosjean, L., & Lane, H., (1979), "The patterns of silences: performance structures in sentence production", *Cognitive Psychology*, 11, 58-81.
Heffner, R-M., S., (1950), GENERAL PHONETICS, The Univ. of Wisconsin Press.
Hirst, D., & Di Cristo, A., (1984), "French intonation: a parametric approach", *Die Neueren Sprachen*, 83, 5, 554-569.

Jones, D., (1909), AN OUTLINE OF ENGLISH PHONETICS, W. Heffner and Sons Ltd, Cambridge, England.
Klatt, D.H., (1976), "Linguistic uses of segmental duration in English: acoustic and perceptual evidence", *J. Ac. Soc. Am.*, 1208-1221.
Konopcynski, G., (1988), "Les oppositions intonatives chez l'enfant préverbal", in Toronto Working Papers of Speech and Voice Society, Vol. 8, 5-29.
Ladefoged, P., & Broadbent, D.E., (1960), "Perception of sequence in auditory events", *J. Exp. Psychology*, 13, 162-170.
Lea, W.A., (1974), PROSODIC AIDS TO SPEECH RECOGNITION: A SUMMARY OF RESULTS TO DATE, Sperry Univac Technical Report, No. PX 11087.
Lehiste, I., (1977), "Isochrony reconsidered", *J. Phon.*, 5, 253-263.
Lehiste, I., Olive, J.P., & Streeter, L.A., (1976), "Role of duration in disambiguating syntactically ambiguous sentences", *J. Ac. Soc. Am.*, 60, 1199-1202.
Léon, P., (1971), "La jonction externe en français: nature et fonctions linguistiques et expressives", Essai de Phonostylistique, *Studia Phonetica*, 4, Didier, 57-66.
Liberman, M. & Prince, A., (1977), "On stress and linguistic rhythm", *Ling. Inq.*, Vol. 8, Number 2, 249-336.
Lieberman, Ph., (1967), INTONATION, PERCEPTION AND LANGUAGE, MIT Press, Cambridge, Mass.
Marouzeau, J., (1934), "Accent d'insistance affectif et intellectuel", *Le Français Moderne*, 2, 120-123.
Mertens, P., (1987), L'INTONATION DU FRANCAIS: DE LA DESCRIPTION LINGUISTIQUE A LA RECONNAISSANCE AUTOMATIQUE, Doctorat, Univ. de Louvain.
Oller, D.K., & Smith, B.L., (1977), "Effect of final-syllable position on vowel duration in infant babbling", *J. Ac. Soc. Am.* 62, 944-997.
Pike, K.L., (1945), THE INTONATION OF AMERICAN ENGLISH, Ann Arbor, Publications in Linguistics, 1, Univ. of Michigan Press.
Roudet, L., (1910), ELEMENTS DE PHONETIQUE GENERALE, H. Welter, Paris.
Rousselot, l'abbé, (1924), PRINCIPES DE PHONETIQUE EXPERIMENTALE, Paris, Didier.
Scott, D.R., Isard, S.D., & de Boysson-Bardies, B., (1985), "Perceptual isochrony in English and in French", *J. Phon.*, 13, 155-162.
Séguinot, A., 1976), "L'accent d'insistance en français standard", *Studia Phonetica*, Didier, 12, 1-58.
Touati, P., (1987), STRUCTURES PROSODIQUES DU SUEDOIS ET DU FRANCAIS, PROFILS TEMPORELS ET CONFIGURATIONS TONALES, Trav. Inst. Ling. Lund.
Vaissière, J., (1971), CONTRIBUTION A LA SYNTHESE PAR REGLES DU FRANCAIS, Thèse de Troisième Cycle, Univ. des Sciences et Lettres, Grenoble 1971.
Vaissière, J., (1974), "On French Prosody", *Quarterly Progress Report*, Massachusetts Inst. of Technology, Res. Lab. of Electr., No 114, 1974, 212-223.
Vaissière, J., (1975), "Further Note on French Prosody", *Quarterly Progress Report*, Massachusetts Inst. of Technology, Res. Lab. of Electr., No. 115, Jan 1975, 251-261.
Vaissière, J., (1983), "Language-independent prosodic features", in PROSODY: MODELS AND MEASUREMENTS, A. Cutler, A. & R. Ladd, (eds.), Springer-Verlag, 53-66.
Vaissière, J., (1989), CONTRIBUTION A L'ANALYSE DES PHENOMENES DE PAROLE CONTINUE LUE, Doctorat d'Habilitation à Diriger des Recherches, Université des Sciences Humaines de Strasbourg.
Wenk, B.J. & Wioland , F., (1982), "Is French really syllable-timed?", *J. Phon.*, 10, 193-216.
Woodrow, H., (1951), "Time perception", Handbook of experimental Psychology, S.S. Stevens (ed.), New-York: Wiley, 1224-1236.