

# LANGUAGE SPECIFIC PATTERNS OF PROSODIC AND SEGMENTAL STRUCTURES IN SWEDISH, FRENCH AND ENGLISH.

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## ABSTRACT

This is a study of temporal patterns of stress in Swedish, English and French, focusing on durations of syllables and phonemes in stressed and unstressed positions. In French we note a finite amount of stress induced segmental lengthening at phrase internal locations which is less prominent than phrase final prepausa lengthening and also smaller than in Swedish and English. If compared on the basis of the same number of phonemes per syllable the stress induced lengthening is less in French than in the two other languages. These results are interpreted within the concept of "stress timing" versus "syllable timing".

## 1. INTRODUCTION

The main purpose of our presentation is to report on some experiments on the realization of stress pattern. We have recently extended our studies of Swedish prose reading [4] to a pilot study of French and English [5]. A primary object has been durational structures. How does stress influence the duration of syllables and individual speech sounds? To what extent will language specific differences in syllable complexity influence overall durations of stressed and unstressed syllables? Can our results contribute somewhat to the perspective of "stress timing" versus "syllable timing"? We have results from a small pilot study of a Swedish text translated into French and English. A few remarks about terminology may be needed. In French phonetics [7] the terms "stress" is often avoided and is replaced by the partial synonym "accent", e.g. in connection with so called "accent d'insistance", indicating a marked accent usually falling in a syllable preceding the one that would otherwise have been ex-

pected to receive some degree of prominence. In French, the phrase and sentence groups, outlined by the intonation pattern and further marked by group final lengthening, is considered primary. In addition, however, there exists - just as in English and Swedish but less apparent - a subdivision of a phrase into smaller units around content words that are mainly marked by local F0 contours. This is what Delattre refers to as "minor continuations" [3]. One outcome of our study is to verify the existence of these prosodic word accents, and to quantify their small but usually finite durational correlates. We have found it profitable to make a general distinction between these minor accents and those which are followed by a pause. Their durational patterns are systematically different.

## 2. RESULTS

Our studies confirm this general view. In all three languages, stressed or accented syllables display a prolonged duration. In French, the stressed induced syllable lengthening is not limited to phrase final, prepausa locations. The phrase internal, minor accentuations are associated with an increase of the order of 50 ms, compared to 100-150 ms for English and Swedish. In French the durational component is often negligible, whilst a typical slow rise of F0 followed by a faster resetting constitutes the remaining cue. Prepausa lengthening was found to be greater in both Swedish and English compared to French. A closer view of stress induced lengthening within a stressed syllable reveals characteristic differences. In all three languages, prepausa lengthening affects phoneme durations in essentially inverse proportion to their distance to the boundary. In French, this pattern con-

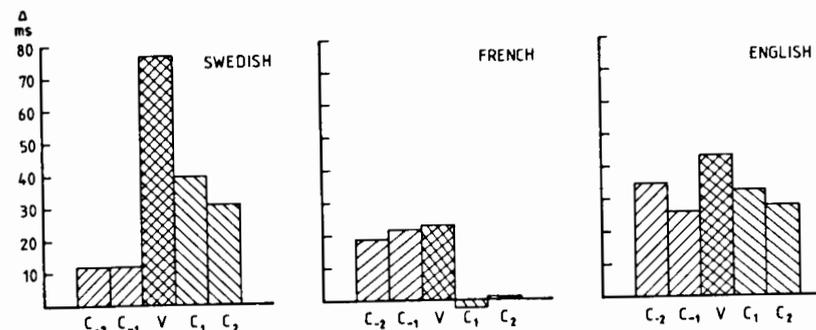


Fig.1. A comparison of stress induced segmental lengthening (measured duration minus unstressed reference) in Swedish, French and English. The cross-hatched columns represent stressed vowels.

trasts drastically to that of the internal minor accents, where consonants after the stressed vowel do not appear to receive any stress induced lengthening. As shown in Fig.1, the lengthening profiles within stressed syllables in nonterminal position are different for French, English and Swedish, with an overweight on consonants following the vowel in Swedish and consonants preceding the vowel in French, whereas in English the profile is more symmetrical. We shall now look more closely into average stressed and unstressed syllable durations in the three languages. Following traditional definitions of syllables and excluding prepausa stresses, we found rather similar values for unstressed syllables, 125 ms for Swedish, 140 ms for English and 130 ms for French. The corresponding values for stressed syllables were 290 ms for Swedish, 300 ms for English and 220 ms only for French.

However, we may argue to what extent these differences depend on syllable complexity. For unstressed syllables we find 2.1 phonemes per syllable for French and 2.3 for Swedish and English. In French the particular distribution is very much dominated by two-phoneme syllables, essentially of CV-type. An apparent difference exists with respect to stressed syllables. In our text we found an average of 3.0 phonemes per syllable

for Swedish, 3.1 for English and 2.3 for French.

Do these differences fully explain the durational data? The answer is no. Our procedure for the test is more fully described in [5]. It accounts to plotting syllable durations against number of phonemes. For Swedish unstressed syllables we find

$$d = 10 + 50m \quad (1)$$

where  $d$  is the syllable duration and  $m$  the average number of phonemes. For English and French we found somewhat larger values for  $m$  greater than 2. For Swedish stressed syllables we obtained

$$D = 57 + 77m \quad (2)$$

The result was similar for English, whilst for French we noted a best fit in terms of

$$D = 81 + 52m \quad (3)$$

Now, if we compare the Swedish and the French data with respect to the same number of phonemes per stressed syllable, e.g.  $m=3$ , we find  $D=290$  ms for Swedish and 235 ms for French. This analysis reflects a true stress induced difference.

We shall now take a more detailed view of the differences between stressed and unstressed syllables in the three languages. Fig.2 shows successive syllables within a long sentence in English, French and Swedish. Here the ordinate is the difference in duration between a syllable and an unstressed reference, determined as the sum of average un-

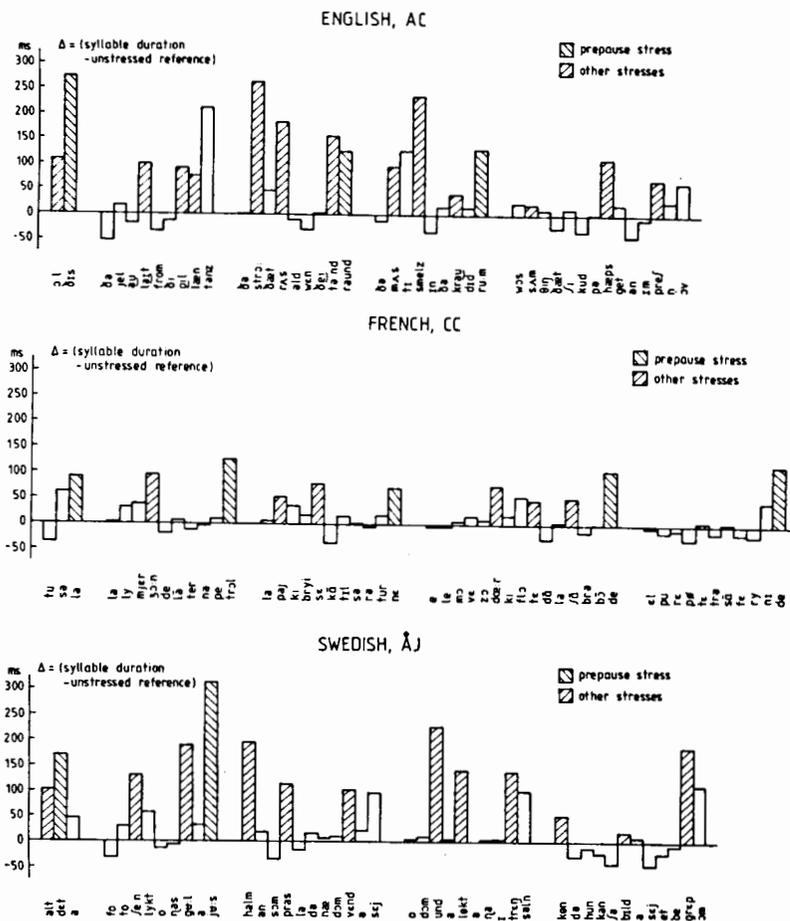


Fig.2. Syllable durations minus unstressed reference values within a sentence in Swedish and in French and English translations.

stressed segmental durations of the phonemes contained. Stressed syllables are cross-hatched. Again we note the smaller stressed/unstressed contrast in French than in Swedish or English. In all three languages the verb phrase - "she could perhaps get an impression of" - at the end of the sentence is deemphasized as seen by the negative values of the normalized syllable durations, indicating in-

creased tempo. In all three languages there is a definitive prepause lengthening, affecting unstressed as well as stressed syllables. There is no phrase initial shortening of unstressed syllables, at least not for French, but unstressed syllables immediately following a non-terminal stress in French tend to be shortened. Occasionally, a phonologically unstressed syllable is lengthened. This is found in the last syllable of the

word "musty" and the first syllable of the word "flottaient", which could be considered as an instance of "accent d'insistance", also seen in the first syllable of "cela". Also the noun "lumière" is somewhat lengthened, supporting the following adjective "jaune". Some of these traits are of course speaker specific but still of some general interest.

### 3. STRESS TIMING VERSUS SYLLABLE TIMING

"Stress timing" versus "syllable timing" are concepts frequently used in language descriptions. The stringency and relevance of these terms, originally coined by Abercrombie [1], have often been questioned. What evidence do we have for referring to Swedish and English as "stress timed" and French as "syllable timed"? The initial postulate concerning stress timing was a constancy of inter-stress intervals irrespective of the number of syllables contained. Since long, this extreme postulate has been refuted [2]. Here follows a condensed summary of our earlier discussion on this issue [5]: (1) Even though weak isochrony tendencies are found in English and Swedish, they do not seem to be of a sufficient perceptual salience to serve as a basis for a theory of stress timing versus syllable timing. (2) Most content words receive some degree of accentuation also in French, which potentially could constitute a basis for stress timing just as in English or Swedish. However, in French the phrase internal stresses are less apparent, whilst the regularity of the succession of syllables becomes dominant. To sum up, we have found that the smaller contrast between stressed and unstressed syllable durations in French compared to English and Swedish is both a matter of a smaller contrast in syllable complexity and a lower degree of stress induced lengthening. In addition, the relative precision and low degree of vowel reduction in unstressed syllables in French reduces the stressed/unstressed contrast. Another argument in the same direction is the relatively moderate F0 span of non-terminal stresses compared to the more dominant prepauses contours. In our view the main arguments for referring to

French as "syllable timed" and Swedish and English as "stress timed" are the following: The stress timing is not a matter of physical isochrony of interstress intervals, but a perceptual dominance of heavy syllables, the succession of which is sensed as quasi-periodical. A language is sensed as syllable timed, when these stress cues, including contrasts in syllable complexity and precision are reduced.

### ACKNOWLEDGEMENTS

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