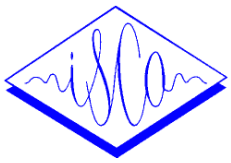

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ACCENTUATION BOUNDARIES IN DUTCH, FRENCH AND SWEDISH

Frédéric Beaugendre[1,3], David House[2] and Dik J. Hermes[1]
[1]IPO, Center for Research on User-System Interaction
P.O. Box 513, NL-5600 MB Eindhoven (Neth.)
[2]Department of Linguistics and Phonetics, Lund University, Lund, (Sweden)
[3]Currently at Lernout and Hauspie Speech Products
Koning Albert-I Laan 64, 1780 Wemmel (Belgium)

ABSTRACT

This paper presents a comparative study investigating the relation between the timing of a rising or falling pitch movement and the syllable it accentuates for three different languages: Dutch, French and Swedish. In a perception experiment, the five-syllable utterances /mamamamama/ and /a.a.a.a.a/ were provided with a relatively fast rising or falling pitch movement. The timing of the movement was systematically varied so that it accented the third or the fourth syllable. Subjects were asked to indicate which syllable they perceived as accented. The accentuation boundary (AB) was then defined as the moment before which more than half of the subjects indicated the third syllable as accented and after which more than half of the subjects indicated the fourth syllable.

The results show that there are significant differences between the different languages as to the location of the AB. In general, for the rises, well defined ABs were found, which for French were located in the middle of the vowel of the third syllable, while for Dutch and Swedish the ABs of the rises were located later in the vowel. For the falls, only for the Dutch and the Swedish listeners WAS a clear AB obtained. This was located at the end of the third syllable. For the French listeners, the fall did not yield a clear AB. This corroborates the absence of accentuation by means of falls in French. Finally, especially for the stimuli with the longer pauses between the /a/'s in Dutch, and perhaps Swedish, an interval was found were the fall induced ambiguity as to accent location.

1. INTRODUCTION

Different studies account for classifications of pitch movements on the basis of their position in the syllable (timing with regard to the onset of the stressed vowel). For example, for rises, two kinds of accent-lending movements are distinguished in the description of Dutch intonation as given by 't Hart, Collier and Cohen [4]: an early rise starting before the vowel onset and a late rise starting after the vowel onset. Similar results are obtained for English [7]. These categories correspond with L+H* and L*+H in autosegmental terminology [2].

For falls, 't Hart et al. [4] present only one phonetic category of full-sized accent-lending falls, while Rietveld and Gussenhoven [9] distinguish two phonological categories H*L and !H*L for Dutch. In Swedish, the rise is coupled to focal accent and is phonologically separate from the two different word-accent falls which are described as H+L* (acute accent) and H*+L (grave accent) [3].

For French, only a small number of studies have investigated the timing of the accent in relationship with vowel onset [10, 1]. Those studies claim that falls do not have a clear function in the accentual structure of French, whereas rises define the melodic variation for a primary accent as a rise on the whole syllable and the melodic variation for a secondary accent as a rise on the consonant preceding the accented vowel.

Recent work on accentuation in Dutch [5, 6] has shown that, first, the main cue which induces the percept of accentuation is located at the onset of a pitch movement. Second, the accentuation boundary is located near the vowel offset, or, when the consonant is lengthened, some tens of ms later. In the present study, Swedish and French subjects will participate in the same tasks. The results obtained for the three languages will be compared. First, it will be tested whether, also for Swedish and French, the cue for accentuation is located at the onset of the pitch movement. Second, the positions of the ABs in the syllables will be compared.

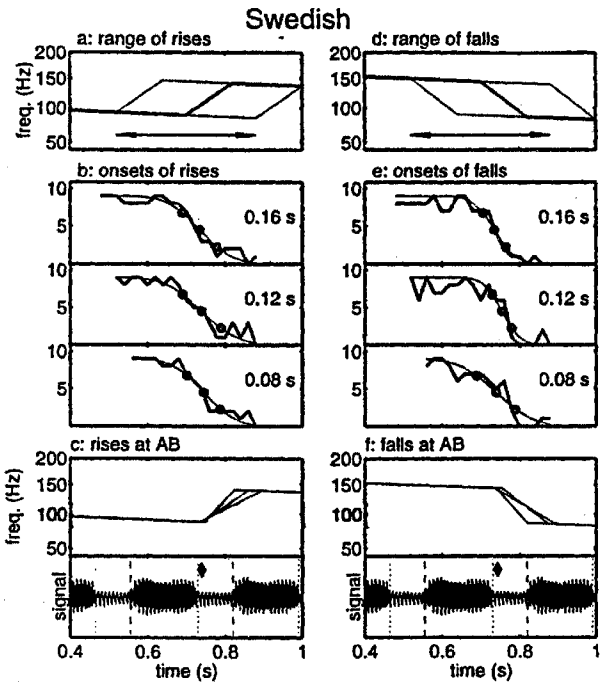

Fig. 1. Results of the /mamamamama/ stimulus with /m/'s of normal duration for the Swedish subjects. For explanations, see text.

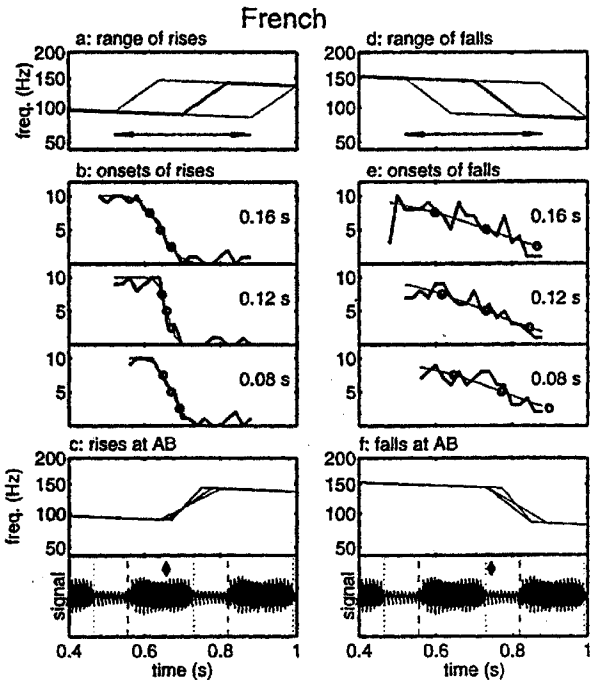

Fig. 2. Results of the /mamamamama/ stimulus with /m/'s of normal duration for the French subjects. For explanations, see text.

2. EXPERIMENT

2.1 Methods

The experiments reported in the present paper were carried out with reiterant five-syllable utterances of the type /mamamamama/ and /a.a.a.a.a/, where /./ indicates a silence comprised of a glottal stop. The middle three syllables were exact replicates of each other as to duration and spectral content. The timing of the pitch movements, rises and falls, was systematically varied in such a way that they accented the third or the fourth syllables. Subjects were asked to indicate which syllable they perceived as accented. The accentuation boundary (AB) was then defined as the moment before which more than half of the subjects indicated the third syllable as accented and after which more than half of the subjects indicated the fourth syllable. In order to find out where in the pitch movement the cue which induces the percept of accentuation is located, the duration of the pitch movement was varied between 80, 120 and 160 ms. In order to find out to which segments of the syllable this accentuation boundary is linked, the durations of the /m/'s in the /mamamamama/ stimuli and the silences between the /a/'s in the /a.a.a.a.a/ stimuli were varied. Stimuli were resynthesized with the original lengths of the /m/ and the /./, half their length, and double their length.

2.2 Subjects and procedures

Eleven Dutch subjects, ten French subjects, and nine Swedish subjects participated in the experiment. The stimuli were presented twice to the Dutch subjects, so there were 22 responses to each stimulus for the Dutch subjects. The experiment was divided into 6 sessions of about 15 minutes each. The stimuli were presented in a random order.

2.3 Results

The results for the /mamamamama/ stimuli with an /m/ of normal duration are presented in Figure 1 for the Swedish subjects, and in Figure 2 for the French subjects. In (a) and (d) the range of pitch movements of the stimuli is indicated: in the left panels for the rise and in the right panels for the fall. This is done for the pitch movement of 120 ms. In (b) and (e) the number of responses '3rd syllable accented' is presented as a function of the onset of the pitch movements. It can be seen that about all subjects indicate the 3rd syllable as accented when the syllable starts early in the vowel. But the later the onset of the rise, the more subjects indicate the fourth syllable. The thin line indicates the cumulative Gaussian distribution function fitted through the onset distribution. The circles are the quartiles of this distribution, the middle one of which is the estimated accentuation boundary. In (c) and (f) the pitch

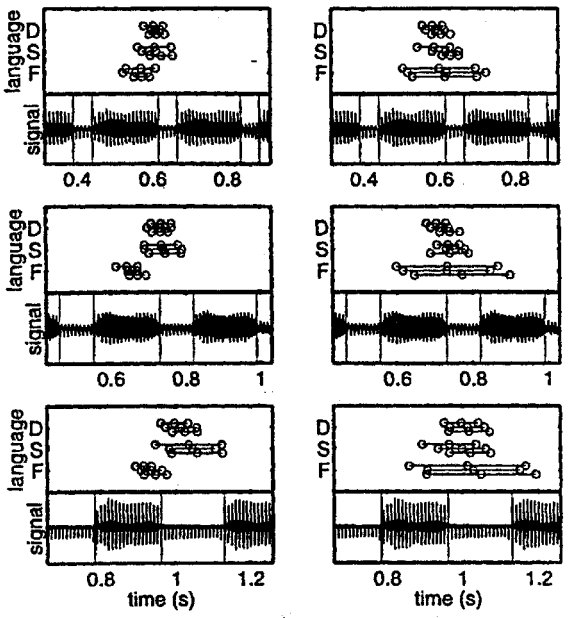

Fig. 3. Quartiles of the onset distributions of the pitch movements at the accentuation boundaries for the /mamamamamama/ stimuli. D = Dutch, S = Swedish, and F = French. Results are presented in triplets, of which the lowest gives the quartiles for the 80 ms pitch movements, the middle those for the 120 ms pitch movements, and the upper those for the 160 ms pitch movements.

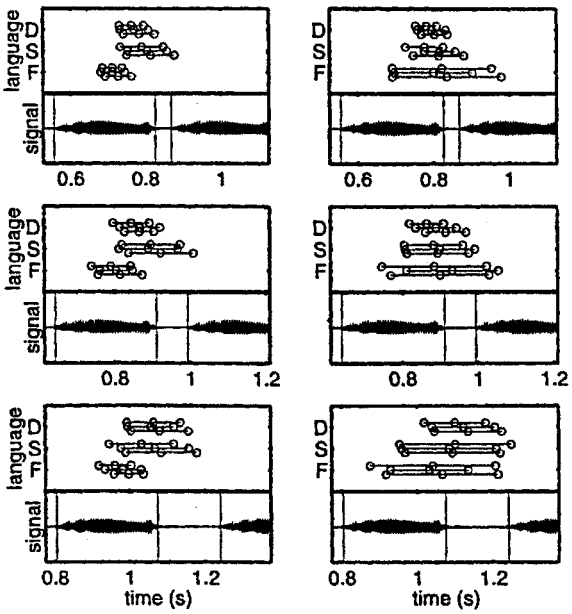

Fig. 4. Quartiles of the onset distributions of the pitch movements at the accentuation boundaries for the /a.a.a.a.a/ stimuli. Results are presented in the same way as in Figure 3.

movements at the obtained accentuation boundaries are shown, in the upper panel the pitch movements, in the lower panel the oscillogram of the stimulus monotonized at 100 Hz. The diamond is the average of the three onsets of the pitch movements at the accentuation boundary as shown in the upper panel of (c) and (f).

The data presented in Figures 1 and 2 show that, for both Swedish and French, the accentuation boundary of the rise is well defined. The same observation is made for the fall in Swedish, but for the fall in French the results were very unclear. In fact, it appeared that French subjects did not reliably indicate a syllable as accented when the pitch movement was a fall. Furthermore, the accentuation boundary of the rise is much later in Swedish than in French. This was also found for the stimuli with the shorter /m/'s and the longer /m/'s, and for the /a.a.a.a.a/ stimuli with silent intervals of three different durations between the /a/'s. Furthermore, the results for the Swedish subjects were similar to those found for Dutch, except that the accentuation boundaries were perhaps somewhat later.

As argued in Hermes [5] the fact that the offsets of the pitch movements move to the right as the pitch movement gets longer, shows that the main cue for accentuation cannot be at the offset of the pitch movements. In addition to the data shown in the figures, this was found to be the case in all situations in which a well-defined accentuation boundary could be established.

An overview of the ABs for the various languages is presented in Figures 3 and 4, which, for Dutch (D), Swedish (S) and French (F), shows the position of the quartiles of the cumulative Gaussian distribution functions drawn through the onset distributions. For each language, the quartiles are presented in triplets, corresponding with the results for the pitch movements of 80 ms (lowest), 120 ms(middle) and 160 ms (upper). Figure 3 presents the results for the /mamamamamama/ stimuli with the /m/'s of different durations; Figure 4 those for the /a.a.a.a.a/ stimuli with the silences between the /a/'s of different durations.

A last result concerns a difference between rises and falls which is especially clear for the results obtained for the /a.a.a.a.a/ stimuli with longer silences. This is shown in Figure 5 for the Dutch subjects. (Probably due to a smaller number of subjects, this is less clear for Swedish.) When the length of the movement exceeds the length of the unvoiced part, there is an apparition of a plateau in the onset distributions. This can be explained by assuming that the silence introduces an "area of ambiguity" where subjects have problems to decide whether the previous or the next syllable is accented.

3. DISCUSSION

The first question we asked was whether also in Swedish and French, as in Dutch, the cue for accentuation of an accent-lending pitch movement is at the onset of the movement. This question can be answered positively, because, in all cases where a clear AB can be determined, the onset of the pitch movements at the accentuation boundaries is rather stable and shifts at most a little bit to the left, while the offset shifts to the right (Figure 1c, 1f, and 2c).

The second question was concerned with the language differences. A clear difference became apparent between Dutch and Swedish on the one hand and French on the other. For the rises, a clear AB can be determined in all three languages. For the stimuli with the short /m/, and the short silence between the /a/'s, the AB is near the vowel offset for Dutch and Swedish; for French, the AB of the rise is in the middle of the vowel. For the stimuli with the longest /m/ and the longest silence, the AB shifts to the interval between the vowels for Dutch and Swedish; for French it shifts somewhat to the right, but remained within the vowel.

For the falls the situation is different. Concerning the French subjects, it appears clearly that they do not classify a syllable as accented when the pitch contour has a falling movement. The onset distributions are very noisy and no clear AB can be determined. This result confirms that falling movements are not used in the accentual structure of French [10, 1].

The difference between Dutch and Swedish subjects is less clear. There is a global tendency for the AB for Swedish subjects to be located about 25 ms later than the AB for Dutch subjects. However, the difference is not constant, and the response of Swedish subjects is less consistent than for Dutch which makes the interpretation of the distributions less clear. For the Dutch subjects, an ambiguous interval becomes apparent especially for the shorter pitch movements and the stimuli with the longer silences. This might play a role in perceived phrasing [8].

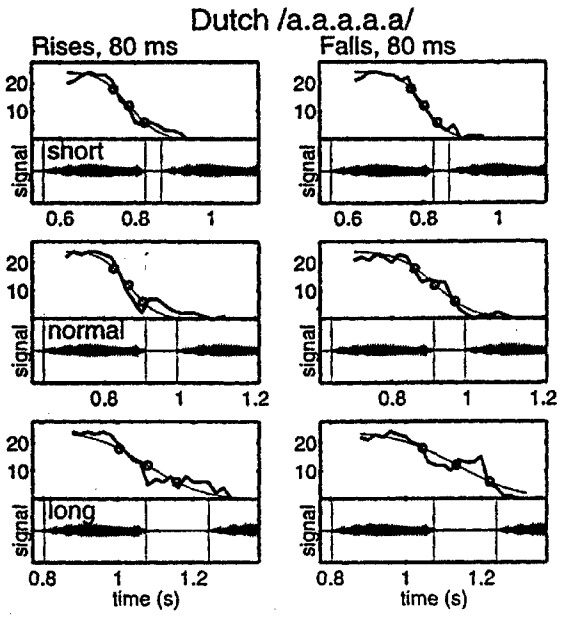

Fig. 5. Onset distributions for the 80 ms rises and falls for the Dutch subjects responding to the /a.a.a.a.a/ stimuli with silences of different durations.

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