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Heldner, M.

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Phonetic correlates of focus accents in Swedish

Mattias Heldner
Department of Phonetics, Umed University, Sweden.

Abstract

This study reports the results of a production experiment conducted to examine the effect of focus on F0-movements (word accent falls and focus accent rises), segment durations, overall intensities and spectral balance. The experiment will serve to provide data on which to model the construction of stimuli in perception experiments aiming at investigating the acoustic cues to perceived focus.

Introduction

"Focus" is the highest level of prominence assumed for Swedish, with the lower levels being "accented" and "stressed" respectively (cf. Bruce, 1993). Placement of focus is a means of signalling to the listener what part of the message contains new information or information judged to be important by the speaker. The most important phonetic correlate of focus is held to be a focus accent rise, i.e. an F0-rise following the word accent fall (cf. Bruce, 1977). However, assuming the focus accent rise to be the most important phonetic correlate of focus neither implies that it is the only correlate, nor that it is a necessary one. Results obtained by for example Fant and Kruckenberg (1994) and Strangert and Heldner (1995) indicate a more complex acoustic signalling of focus, with segmental durations, overall intensity, spectral balance and features of the voice source possibly being important in the signalling of focus, too. That is, the focus accent rise might be just one of several sufficient correlates, each of which may evoke the perception of focus.

Thus, in the present study the effect of focus on F0-movements (word accent falls and focus accent rises) is examined. In addition, the possible effect of focus on segment duration, overall intensity and spectral balance (i.e. the intensity in two contiguous spectral bands) are investigated. The purpose is to collect production materials for Central Standard Swedish to be used for the construction of stimuli in later perception experiments. These experiments aim at investigating the acoustic cues to perceived focus and thus to determine whether the F0 rise, as assumed, is a necessary or just a sufficient cue to perceived focus.

Material and procedure

One male speaker produced seven repetitions of four pairs of questions and answers. Four target words, two with acute accent (be'nämna and 'nummer) and two with grave accent ('änmåla and 'nunnor), were embedded in two positions (medial and final) in the response sentences. Depending on the question, either the medial or final target word was focused. The question-answer pairs are shown in Table 1.

Table 1. The speech material. Target words are underlined, capitals mark focus placement.

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vilka linjärtecken vill man benämna?</td>
<td>Man vill benämna några linjär NUMMER.</td>
</tr>
<tr>
<td>Vad vill man göra med några linjär nummer?</td>
<td>Man vill BENÄMNA några linjär nummer.</td>
</tr>
<tr>
<td>Vilka lama damer vill man anmåla?</td>
<td>Man vill anmåla några lama NUNNOR.</td>
</tr>
<tr>
<td>Vad vill man göra med några lama nunnor?</td>
<td>Man vill ANMÄLA några lama nunnor.</td>
</tr>
</tbody>
</table>

The acoustic analysis was restricted to the answers of the question-answer pairs. It was based on synchronised oscillograms, broad band spectrograms, F0 plots, overall intensity curves and filtered intensity curves in two contiguous frequency bands, LP (0-500 Hz) and HP (500 Hz and above).

To measure F0 movements within the target words, four measuring points were defined on the basis of the F0 tracings. WA1 and WA2 mark the beginning and the end of the word accent fall. FA1 and FA2 mark the beginning and the end of the focus accent rise. To measure durations, markers were placed at segment boundaries determined by visual inspection of oscillograms and wide band spectrograms. For each segment, the rms-value of the overall intensity and the intensity in the LP and HP frequency bands were measured.

Repeated measures analysis of variance models were constructed for each target word...
and for each type of data, i.e. F0-value, segment duration, overall intensity and spectral balance (intensities in the HP- and LP-band). Focus condition occurred as one independent variable in all models and the second independent variable was either measurement points (for the F0-movements analysis) or segments (for the duration, overall intensity and spectral balance analyses), respectively. Means comparisons contrasts were carried out to examine the interactions, and especially the difference between the two focus conditions for each level of the other independent variable.

**Results**

The results of the analyses are shown in Figures 1-5. As the main effects are of less importance here, only the interactions and contrasts will be commented on. Asterisks in the figures indicate a significant contrast between the two focus conditions for a particular level of the other independent variable. The absence of an asterisk indicates a non-significant interaction. For all analyses throughout this article, a significance level of 5% was chosen.

**F0-movements**

Figure 1 shows the interaction between focus condition and measurement points in the F0-movement analysis. The results confirmed that focused words were characterised by a (focus accent) F0-rise following the word accent fall. Moreover, the size of the word accent fall was increased in focused grave words, compared to nonfocused whereas it was decreased in acute words.

**Segment durations**

Figure 2 shows the interaction between focus condition and segments in the segment duration analysis. Focused words were significantly longer. The lengthening of acute words occurred mainly in the consonants surrounding, and in the stressed vowel. Grave words were mainly lengthened in the poststress vowel and in surrounding consonants. With the exception of the target word ‘numnor’ it appears that acute words in focus are lengthened mainly in the accented syllable whereas grave words are lengthened mainly in the following syllable.

**Overall intensities**

Figure 3 shows the interaction between the focus condition and segments in the overall intensity analysis. Apart from minor differences between the two focus conditions in medial position, the focused words in final position clearly had higher intensities than their nonfocus counterparts.

**Spectral balance**

Figures 4 and 5 show the interaction between focus condition and segments in the spectral balance analysis. Only minor differences were found between the two focus conditions for target words in medial position. The intensities in both the LP- and HP-bands in final position, however, were higher in focus for a majority of the segments.

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**Figure 1.** Mean F0 values with error bars representing ± 1 standard deviation for the measuring points WA1, WA2, FA1 and FA2 in the target words 'benämna', 'annåla', 'numnor' and 'numnor' in two focus conditions, focused [+F] and non-focused [-F].
Discussion

Summarising, marked focus accent rises and word accent falls as well as lengthening of segments seem to be reliable correlates of focus in both medial and final sentence position. Effects of overall intensity and spectral balance seem to be restricted to final position. In the non-focus condition, medial and final position, respectively, exhibit different patterns, which might reflect the distinction between 'accented' and 'stressed' (deaccented) in the prominence hierarchy. In final, non-focus position, F0 and intensity is lower and there is less segmental lengthening than in medial position. Bruce (1982) describes accented words following a focus accent as downstepped and diminished in range. If this downstep (combined with low intensity and very little segmental lengthening) also causes a lowering of prominence, there might be reason to treat the nonfocus target words in final position as stressed and non-focus words in medial position as accented.

The relevance of the different cues to perceived focus will be explored in separate studies.

Acknowledgements

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Figure 4. Mean segment intensities in dB with error bars representing ±1 standard deviation for the target words in medial position in two contiguous bands HP and LP in two focus conditions.

Figure 5. Mean segment intensities in dB with error bars representing ±1 standard deviation for the target words in final position in two contiguous bands HP and LP in two focus conditions.

References
