The interaction of word accent and quantity in Gothenburg Swedish

My Segerup
Department of Linguistics and Phonetics, Lund University, Lund
E-mail: My.Segerup@ling.lu.se

Abstract

According to the conventional wisdom the word accent distinction in Swedish (dialects) is maintained chiefly by a difference in the timing of the word accent gesture (Gårding, 1973). Gothenburg Swedish, however, does not obey to the norm since both pitch height and timing contribute to the word accent distinction in this dialect (Segerup, 2004). In Gothenburg Swedish both word accents have a fall on the stressed vowel, which makes the pitch contours strikingly similar (Segerup, 2004).
Up until now the material investigated has consisted of contrastive words in which the stressed vowel is phonologically long. In the present production study we proceed with word-pairs where the stressed vowel is phonologically short for a comparison. The acoustic analysis involves measurements of fundamental frequency (F0) and segments' duration of five speakers' production of seven word-pairs altogether.
The results show a significant difference in the duration of the short stressed vowel between accent 1 and accent 2. Further, that word accent has effects on the vowel duration

INTRODUCTION

The present paper investigates the interaction between word accent and quantity in Gothenburg Swedish. Minimal pairs with accent 1 and accent 2 and with either long or short stressed vowel are examined. How are pitch height and timing affected when the voiced portion of the syllable is minimized by having a short vowel followed by a voiceless consonant as opposed to a more sonorant environment, i.e. a long vowel or sonorant consonant? This is related to the general question of truncation or compression of the f_0 contour in an intonationally unfavourable environment (see e.g. Bannert & Bredvad-Jensen, 1975).

Background

According to the Swedish tonal typology (Gårding, 1973, with Lindblad 1975, Bruce & Gårding, 1978) the timing/alignment of the word accent gesture is essential to the Swedish word accent distinction.

The traditionally described word accent pattern of the West Swedish prosodic dialect type (see Bruce & Gårding, 1978) involves low pitch on the stressed vowel for accent 1 words and a peak on the stressed vowel for accent 2 words in focal position. Bruce (1998) has suggested that Gothenburg Swedish is characterized by two-peaked pitch contours for both word accents with an earlier timing in accent 1. A previous production study (Segerup, 2004) confirms that Gothenburg Swedish accent 1 deviates from the generally accepted West Swedish accent 1 pattern through having a fall on the stressed vowel. Furthermore, the fall of accent 2 is only marginally later than that of accent 1, meaning that the expected timing difference between accent 1 and accent 2 is less than in other dialect types. Consequently, the overall shape of the pitch contours is strikingly similar, but yet they are perceptually distinct (Segerup, 2004, Segerup & Nolan, forthc.).

Pitch height and timing – collaborating cues

Perhaps the most unexpected finding of the production study summarized above is that accent 2 was shown often to involve higher pitch in the stressed vowel than accent 1. The result of the acoustic analysis shows that the word accent distinction is maintained by comparatively small differences in the timing and height of the fall and further that speakers apparently use different strategies in order to maintain the distinction. Some speakers rely primarily on one cue or the other, other speakers rely on both.

In order to find out whether listeners attend to pitch height or disregard it most likely as an unintentional consequence of producing the alignment difference, a perception experiment was carried out (Segerup & Nolan, forthc.). The stimuli used in the experiment were resynthesized from natural utterances with alignment and pitch height varied systematically. Twenty-four native speakers of

Gothenburg Swedish served as subjects. The results show that listeners do take note of the height from which the fall takes place as well as the alignment of the fall.

The results of the production and perception study above suggest that there is a trading relationship between pitch height and timing, meaning that these two independent dimensions contribute in various proportions to the perception of the word accent distinction (Segerup & Nolan, forthc.).

Purpose

The purpose of the present study is to investigate the interaction between word accent and quantity, and, further, to investigate whether there is a difference between accent 1 and 2 as regards the duration of the short stressed vowel and long stressed vowel, respectively.

INVESTIGATION

Materials, subjects, method

The speech materials comprise seven contrastive di-syllabic word-pairs, all of which are listed pair-wise in Table 1 below. (Since the present investigation is part of a large-scale study, the word-pairs included here are not completely symmetric). The target words, in phrase-final focal position, were extracted from various sets of sentences (statements) spoken in two different speaking styles; normal and clear voice.

Table 1. Contrastive word-pairs included in the present study.

Accent 1 V:	***Accent 2 V:***
Polen (Poland)	pålen (the stake)
Judith	ljudit (to have sounded)
malen (the moths)	malen (ground)
buren (the cage)	buren (carried)
Accent 1 V	***Accent 2 V***
pollen (pollen)	pållen (horsey)
tecken (signs)	täcken (quilts)
tjecker (Czechs)	checker (cheques)

Speakers were five elderly male native speakers of Gothenburg Swedish. The recordings were made using a portable DAT recorder in the subjects' local environment. Two sets of recordings were made on two separate occasions. A Gothenburg Swedish interlocutor read various questions, to which the subjects read the answer (which proved to induce very natural and colloquial speech). At least three (but up to nine) repetitions of every sentence in each speaking mode (in random order) were recorded for each of the 5 speakers.

The total number of tokens (including all 5 speakers' repetitions) in the present analysis varies from approximately 15 to 28 tokens per word in each speaking style.

Acoustic analysis

The acoustic analysis includes segments' duration and seven measurements of pitch values at specific pre-selected points. These are; the height of the preceding vowel (1), the start of the stressed vowel (2), the top corner of the fall (3), the bottom corner of the fall (4), the start of the rise (5), the phrase accent peak (6), and the end (7). In the case where the stressed vowel is followed by a voiced/voiceless consonant, the measurement point (5) is at the onset of the second vowel. In Figures 1-3 below the measurement points are marked by triangles for accent 1 and squares for accent 2.

RESULTS

The results of the acoustic analysis are exemplified in Figures 1-4. Figures 1-3 show the average f_0 curves for five speakers' production of malen/malen, pollen/pållen and tecken/täcken in clear style, respectively. The duration of the stressed vowel is indicated by a bar (at the top for accent 2 and at the bottom for accent 1). The pitch contours are aligned at the start of the stressed vowel and earlier points are shown as having negative times relative to the alignment point. In words with a long vowel the duration of the stressed vowel and the overall timing of the two word accents is very similar, meaning that a direct comparison of the timing of pitch events is possible, which is generally not the case in words with a short vowel.

Figure 4 compares, for accent 1 and accent 2, the average duration of the stressed vowel for the word-pairs malen/malen, pollen/pållen and tecken/täcken.

It is clear from the acoustic results that words with a short vowel behave differently from words with a long vowel. Words with a long vowel (Judith/ljudit, Polen/pålen and buren/buren) behave nearly the same as malen/malen, which is shown in Figure 1. For both accents the f_0 contour is falling throughout the vowel segment from an initial f_0 maximum (defined as the top corner of the fall), which starts slightly later at a higher frequency level for accent 2 than for accent 1, to an f_0 minimum (the bottom corner of the fall) at the end of the stressed vowel.

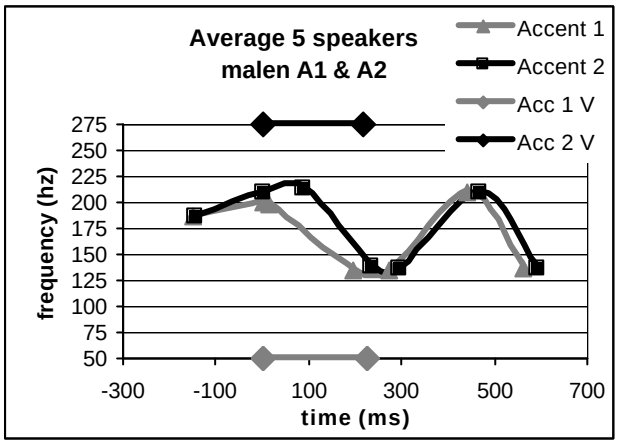

Figure 1. Average fundamental frequency contours for accent 1 (triangles) and accent 2 (squares) for five speakers. The first point in the curves is in the preceding unstressed vowel. The bars show the duration of the stressed vowel for accent 1 (bottom) and accent 2 (top). Times are expressed relative to the onset of the stressed vowel.

There is no durational effect of accent evident in long vowel words, while this does seem to be the case in short vowel words. The difference seen for pollen/pållen (Figure 2) and tecken/täcken (Figure 3) was also seen for tjecker/checker.

In the short vowel contours of pollen and pållen (Figure 2) the main pattern of the f_0 contours of the long vowel words is preserved. Even if the fall of accent 1 pollen starts comparatively late into the vowel, the f_0 contour is falling rapidly through the second part of the vowel to a final Low, approximately at the VC-boundary.

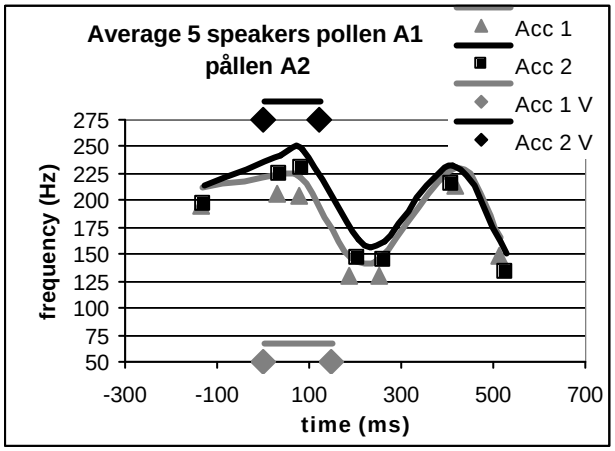

Figure 2. Average fundamental frequency contours for accent 1 (triangles) and accent 2 (squares) for five speakers. The first point in the curves is in the preceding unstressed vowel. The bars show the duration of the stressed vowel for accent 1 (bottom) and accent 2 (top). Times are expressed relative to the onset of the stressed vowel.

The falling f_0 contour of accent 2 starts at a higher frequency level and with slightly later timing than the fall of accent 1 and reaches Low in the following consonant.

Figure 3 reveals a further effect. In tecken/täcken and tjecker/checker (not shown here) where the voicing part is very short it appears that speakers compress the fall in accent 1, so that the Low is achieved at the end of the short vowel, whereas in accent 2 the pitch stays high at the end of the stressed vowel. The graph interpolates to the Low measured at the beginning of the second vowel, so that the true slope of the fall cannot be determined because of the voicelessness.

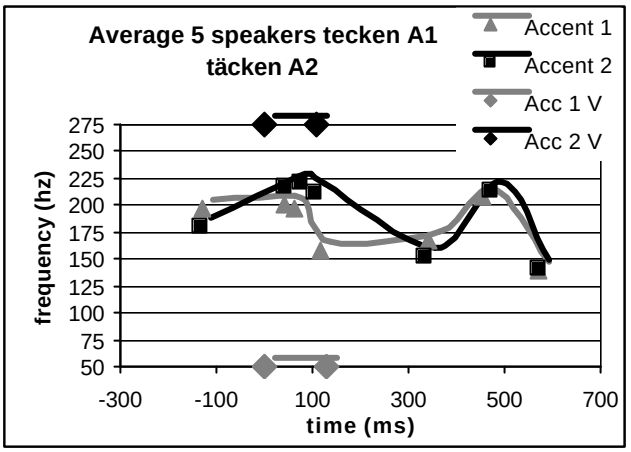

Figure 3. Average fundamental frequency contours for accent 1 (triangles) and accent 2 (squares) for five speakers. The first point in the curves is in the preceding unstressed vowel. The bars show the duration of the stressed vowel for accent 1 (bottom) and accent 2 (top). Times are expressed relative to the onset of the stressed vowel.

From the results it is obvious that the gradient of the fall in accent 1 differs between long vowel words and short vowel words. The results suggest that the gradient of the fall also differs between short vowel words, i.e. between words where the stressed vowel is followed by a voiced consonant versus a voiceless consonant. The gradient of the fall in tecken appears to be twice as steep as that of malen, while the gradient of the fall in pollen is approximately in between that of malen and tecken.

Figure 4 compares the duration of the stressed vowel of accent 1 and accent 2 for comparison between malen/malen, pollen/pållen and tecken/täcken. The difference in duration of the short stressed vowel between accent 1 and accent 2 is noticeable.
A t-test showed this difference to be significant for each individual speaker in each speaking style (at 5 % level). One exception is tjecker/checker in clear

speaking style, where two of the speakers' vowel duration for accent 2 was only marginally shorter than that of accent 1.

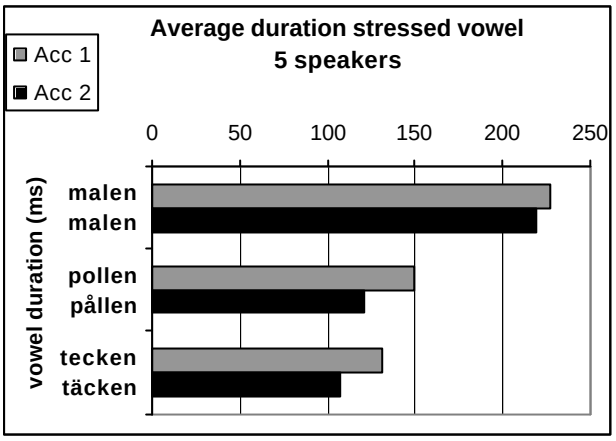

Figure 4. Average duration (ms) of the stressed vowel for malen/malen, pollen/pållen and tecken/täcken five speakers. Accent 1 is represented by the light bar and accent 2 by the dark bar.

DISCUSSION

In Gothenburg Swedish short vowel words, accent 2 seems to demonstrate truncation of the pitch fall and accent 1 seems to demonstrate compression of the fall and also some lengthening of the stressed vowel. It appears to be the case that Gothenburg Swedish speakers' strategy is to preserve the fall on accent 1, while the fall seems to be of less importance for accent 2.

One interpretation of this is that the falling f_0 contour in the stressed vowel of accent 1 and the height from which the fall takes place in accent 2 is enough of a cue to maintain the distinction between the word accents in words with a short stressed vowel. House (1990) has worked with a model of tonal feature perception which may be applied to these findings.

In order to fully understand the interaction of these cues a perceptual experiment with synthetic stimuli is in preparation, which will manipulate pitch height and slope in order to discover the relative importance of these factors.

References

Bannert R. and Bredvad-Jensen A-C. (1975) Temporal organization of Swedish tonal accents: The effect of vowel duration. Working Papers (Phonetics Laboratory, Department of general Linguistics, Lund University) 10,1-26.

Bruce G. and Gårding E. (1978) A prosodic typology for Swedish dialects. In Gårding G., Bruce G. and Bannert R. (eds) Nordic Prosody: Papers from a symposium (Department of Linguistics, Lund University) 219-229.

Bruce G. (1998) Allmän och svensk prosodi (Department of Linguistics, Lund University) 16.

Gårding E. (1973) The Scandinavian word accents. Working papers (Phonetics Laboratory, Lund University) 8.

Gårding E. and Lindblad P. (1975) Constancy and variation in Swedish word accent patterns. Working papers (Phonetics Laboratory, Lund University) 3, 36-100.

House, D. (1990) Tonal Perception in Speech. (Traveaux de l'Institut de Linguistique de Lund, Lund University) 24.

Segerup M. (2003) Word accent gestures in West Swedish. In Heldner M (ed.) *Proceedings from FONETIK 2003, Phonum (*Department of Philosophy and Linguistics, Umeå University) *9*, 25-28.

Segerup, M. (2004) Gothenburg Swedish word accents – a fine distinction. In Branderud, P. & H. Traunmüller (eds). *Proceedings Fonetik 2004* (Department of Linguistics, Stockholm University) 28-31.

Segerup, M. & Nolan F. (forthc) Gothenburg Swedish word accents – a case of cue trading? Nordic prosody (Department of Linguistics and Phonetics, Lund University) IX.