

# Acoustic character of vowel pronunciation in Sweden-Swedish and Finland-Swedish

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## Abstract

*This paper presents some of the main results of a study on the acoustic character of vowel pronunciation in Sweden-Swedish and Finland-Swedish.*

## 1 Introduction: Purpose, method, and material

This paper presents some of the main results of a study on the acoustic character of vowel pronunciation in Sweden-Swedish and Finland-Swedish made by the author (Kuronen 2000). The investigation was accomplished with Intelligent Speech Analyser, a program developed by Raimo Toivonen, Pitchsystems Oy ([www.sci.fi/~pitchsys](http://www.sci.fi/~pitchsys)). The investigated parameters were frequencies of formants 1-4, changes in formant frequencies during a vowel, amplitude of some formants in some vowels, duration, fundamental frequency, possible occurrence of unperiodic energy and possible occurrence of perceptual formant integration. Formant frequencies were measured from both LPC- and FFT-spectrograms. FFT-spectrograms and LPC-waterfall depiction were used in the analysis of diphthongization. In the interpretation of the acoustic results the psychoacoustical concepts of Critical band of the ear and Bark (Zwicker 1982, Iivonen 1994) were used. Comments based on careful listening by the author are also given in the study.

The investigated Sweden-Swedish dialect is the language spoken in Nyköping, a town located about one hundred kilometers southwest of Stockholm. Nyköping is often mentioned among those towns where the so-called Standard-Swedish variant of Central-Swedish is spoken (Gjerdman 1927, for critical remarks about this subject see Josephson 1997). The investigated Finland-Swedish variant is the language spoken in Helsinki. This dialect can be considered to represent well the somewhat imaginary Finland-Swedish standard pronunciation.

Both groups were represented by four male and four female informants. Each of the investigated speakers pronounced 7-10 stressed long and short allophones of every phoneme in natural frame sentences. Unstressed vowel pronunciation was also investigated. The speech material was identical for both speaker groups.

Although studies have been made on vowel acoustics earlier in Sweden-Swedish (e.g. Fant 1969, Bleckert 1971) and – to a much smaller extent – in Finland-Swedish (Reuter 1971), the speech materials have been of very different character and comparisons are of that reason difficult or impossible to make.

## 2 The main results

### 2.1 Sweden-Swedish

In Sweden-Swedish most of the sentence-stressed long allophones undergo diphthongiza-

tion. This diphthongization is clearly audible in fluent speech, especially in the stressed vowels of words like *veta*, *dålig* and *äta*. These three vowels have an opening diphthongization so that F1 is about 1-1.5 Barks higher at the end than at the beginning of the vowel. F2 also undergoes a remarkable change in these vowels: in *veta* and *äta*, etc. F2 is 1-2.5 Barks lower at the end than at the beginning of the sound, while F2 goes up by 1-1.5 Barks in [o:]. 60-80% of the total formant frequency change takes place during the second part of the sound in all these three vowels. The beginning of the sound is, in other words, acoustically much more stable than the end. Especially in [e:] there is a distinct transition phase in the middle of the sound. This transition phase is 20-30% of the sound's total duration and 70-80% of the total formant frequency change takes place during this phase.

An articulatory opening diphthongization can also occur in the vowels of words like *hög*, *tal* and *du*, but in most cases the diphthongization in these vowels is just an acoustic phenomenon and can not be heard in fluent speech.

The long allophones of /i/, /y/ and /u/ also undergo diphthongization, but it is of an opposite character compared with non-close vowels. In [i:], [y:] and [u:] F1 is 0.5-0.7 Bark lower at the end than at the beginning of the sound. Both F2 and F3 are clearly higher at the end than at the beginning of [i:] and [y:], while F2 falls by about 1 Bark in [u:]. Furthermore the only two vowels in which a fricative sound can occur in the final part of the vowel are [i:] and [y:]; this was the case in half of the investigated sentence-stressed [i:] and [y:] sounds. Somewhat surprisingly no unperiodic energy occurred in [u:].

In accordance with Fant's (1969) results for Central-Swedish, both the F1- and the F2-difference between [i:] and [y:] are less than one Bark in my material. The distinctive acoustic feature between sentence-stressed [i:] and [y:] is the higher F3 in [i:] than in [y:]. Although F3 can in [y:] at the beginning of the sound occasionally be nearly as high as in [i:], F3 is about 1 Bark higher at the end of [i:] than at the end of [y:]. In other words, diphthongization increases the difference between sentence-stressed [i:] and [y:]. Diphthongization also increases many other vowel oppositions. For example, the initial part of sentence-stressed [i:] and [e:] is often identical and the diphthongization during the final part of these sounds makes them different. This is also true of the difference between [o:] and [u:].

The direction and the durational character of the diphthongization is resistant to both individual and situational variation in Nyköping. However, the strength of the diphthongization depends on how strongly the vowel is stressed. In secondary stressed syllables the diphthongization is audible only in [e:].

The diphthongization in the dialect spoken in Nyköping seems to be almost identical with the diphthongization in Eskilstuna (Bleckert 1971). The only difference between Nyköping and Eskilstuna seems to be that [i:] and [y:] have an opening diphthongization in Eskilstuna, while the acoustical movement is the opposite in Nyköping. This difference can be apparent: in my material as well, [i:] and [y:] can undergo opening diphthongization, but this is the case only in prepausal sounds and it is therefore more a junctural or syntactical (cf. articulatory release phase) than a segmental phenomenon. Even [u:] can have an opening diphthongization in my material, but this happens only in prepausal positions.

Some Sweden-Swedish speakers have, on several occasions, an open monophthong in stressed *väg*, *tät*, etc. and the opposition between *tät* and *tär*, etc. is lost. The vowel in *väg*, etc. varies between the speakers most of all of the investigated sounds: five of eight speakers have a clearly audible diphthongization in sentence-stressed position often, while two have an open monophthong in most positions. One speaker has an open-mid monophthong in most positions and no diphthongization.

Most of the speakers make little or no difference between the stressed vowels in words like *höta* and *höra* because both vowels are pronounced with a central mid vowel. Accord-

ing to Elert (1995) this pronunciation is becoming more and more usual in many parts of Uppland, Södermanland, Östergötland and Närke (see also Nordberg 1975 and Kotsinas 1991). It may be the case that the same kind of a more open articulation as in *hö*, etc. is also becoming more and more usual in *väg*, etc. in many parts of Sweden.

The total amplitude level during the long allophones goes down in Sweden-Swedish by 2 to 7 dB, but clearly more in the stressed vowels of words like *bo* and *du*. In these two vowels the amplitude level is 10-14 dB lower at the end than at the beginning of the vowel. This feature is probably of great importance for the correct identification of these vowels.

The durational relation between the short and the long allophone of the same phoneme is on average 67% in the dialect spoken in Nyköping. The relative duration of the short allophone is highest in pairs like *full-ful* (V/V:-relation 78%) and *vall-val* (71%). The lowest V/V:-relations were found in /o/ (58%) and /u/ (60%).

The qualitative difference between the short and the long allophone is remarkable in Sweden-Swedish. Only in two vowels, /ø/ and /æ/, is the qualitative difference between the short and the long allophone less than one Bark for both F1 and F2.

Many of the Sweden-Swedish speakers make little or no difference between the stressed vowels in words like *tröst*, *trust* and *dörr*. There is a tendency in my material for especially male speakers not to maintain the auditive difference between these three sounds.

## 2.2 Finland-Swedish compared with Sweden-Swedish

Finland-Swedish vowel pronunciation differs in many respects from Sweden-Swedish. The biggest differences are (i) the slight qualitative difference between the long and the short allophone of the same phoneme in Finland-Swedish (one Bark or less in every phoneme), (ii) the non-peripheral character of Finland-Swedish pronunciation concerning close front and back vowels and (iii) the big durational difference between the short and the long allophones. Furthermore no diphthongization occurs in Finland-Swedish long allophones. It is possible that the lack of diphthongization in Finland-Swedish is due to the fact that no phonetic difference is made between words like *leka* and *läka* and therefore only three different heights exist for front vowels: /i/, /e/ and /æ/. This means that each of these sounds has more acoustic and auditory space in Finland-Swedish than, for example, in Central-Swedish, and extra features in the form of diphthongization are not needed.

All three main differences between Sweden-Swedish and Finland-Swedish mentioned above are probably in some degree caused by Finnish influence on Finland-Swedish. As is well known, the long allophones of Finnish (Wiik 1965, Iivonen & Laukkanen 1993) are more central than in Sweden-Swedish and the qualitative difference between the short and the long allophone of the same phoneme is relatively little in Finnish. Because the majority of Finland-Swedish speakers are bilingual and because the vowel systems of Swedish and Finnish are similar in many respects, the circumstances for Finnish influence on Finland-Swedish are favorable. If we furthermore suppose that the long close allophones in Finland-Swedish are non-peripheral in comparison to Sweden-Swedish due to Finnish influence, it is logical that the slight qualitative difference between the short and the long allophone of the same phoneme in Finland-Swedish as well is caused by Finnish influence. It is in other words not a question of an independent dialectal development as suggested earlier (Niemi 1981).

Compared with Sweden-Swedish, in Finland-Swedish F1 is 0.5-1 Bark higher in non-open long allophones. The biggest F1-difference is found in [e:] and [o:]: in Finland-Swedish in these sounds F1 is about 1 Bark higher than in Sweden-Swedish.

The durational relation between the short and the long allophone of the same phoneme is on average 51% in Finland-Swedish. The relative duration of the short allophone is highest in /i/ (V/V:-relation 57%) and lowest in /u/ and /o/ (49%).

In Sweden-Swedish, the formant frequency difference between F2 and F3 is less than 3.5 Barks in [i:], [y:] and [e:] and these formants are inside the broad auditory spectral band (cf. Chistovich et al. 1979). This is not the case in Finland-Swedish and therefore when F2'-values are considered, in comparison with Finland-Swedish the Sweden-Swedish pronunciation of these vowels is even more peripheral than separate F2- and F3-values would suggest.

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