The postvocalic consonant as a complementary cue to the perception of quantity in Swedish – a revisit

Bosse Thorén
Dept. of Linguistics at
The University of Stockholm

Abstract

Is the duration of the post-vocalic consonant in stressed syllables an important property when teaching Swedish as a L2? Is it a cue to the discrimination of /V:C/ and /VC:/ words or a buffer for proper syllable duration, or both? Four Swedish words, providing two minimal pairs with respect to phonologic quantity, and containing the vowel phonemes /ɛ/ and /ʉ/, were gradually changed temporally from /V:C/ to /VC:/ and vice versa. Manipulations of durations were made in two series – one with changing of vowel duration only, and one with changing of vowel and consonant duration in combination. 30 native Swedish listeners decided whether they perceived test words as original quantity type or not. The results show that the duration of the post-vocalic consonant had substantial influence on how the listeners categorized the test words. The study also includes naturalness judgements of the test words, and here the "proper" post-vocalic consonant duration had a positive influence on the listener's judgements of naturalness for /ɛ/ but not for /ʉ/.

Introduction

Teaching and learning the pronunciation of a second language comprises many considerations as to what phonetic features are more or less important in order to – on the one hand – make oneself understood, and on the other hand not to disturb the listener. Bannert (1984) states:

> "…to improve pronunciation when learning a foreign language, … linguistic correctness has been the guiding principle. It seems however, that hardly any consideration has been given to the native listener's problems of understanding foreign accent".

In the past 20-25 years, a simplified description of Swedish prosody for pedagogical use has appeared in a number of teaching media (Kjellin 1978, Fasth & Kannermark 1989, Slagbrand & Thorén 1997). The description is based on the temporal organization of Swedish, with stressed syllables having longer duration than unstressed, and the well known quantity contrast in stressed syllables, manifesting itself as either /V:C/ or /VC:/. The simplified prosodic description is henceforth called basic prosody, or BP, and it can in the teaching situation be reduced to a short recommendation: "lengthen the proper speech sound", thus aiming at enhancing the word stress as well as the quantity contrast, both of which depend mainly on duration as perceptual cue for the listener (Fant & Kruckenberg 1994, Thorén 2003). Measuring of Swedish syllable duration has shown that stressed syllables are 50-100% longer than unstressed syllables (e.g. Strangert 1985). If a stressed syllable containing a short vowel is going to be lengthened, an increased post-vocalic consonant duration is one way of maintaining the proper duration of the stressed syllable.

The importance of Swedish word stress is studied by Bannert (1986) who showed that word stress on the improper syllable can make otherwise familiar words unintelligible to the Swedish listener. The importance of the quantity contrast is evident from the fact that there are numerous minimally contrasting word pairs, also within the same part of speech. The role of duration as an important cue to both the word stress and the quantity feature makes it reasonable to assign it great importance in Swedish pronunciation. Thorén (2001) showed that digitally increased duration in phonologically long segments in Swedish with a foreign accent tended to be judged as improved Swedish pronunciation by native Swedish listeners. The study showed similar effect for lengthening of both vowel and consonant duration. The non-native speaker in the study was Polish, and Polish is a language without phonological quantity.

The last mentioned study deals with the duration feature as maintainer of euphony rather than phonology, and BP is assumed to enhance naturalness as well as the word stress and the quantity contrasts. In this intricate

interplay between sentence stress, word stress and quantity, the perceptual role of the post-vocalic consonant is probably the least explored property. The present study is an attempt to evaluate the role of the duration of the post-vocalic consonant as a cue to the phonologic quantity contrast.

In addition to temporal corelates, the phonological quantity contrast is also known to use different proportions of spectrum as perceptual cue, depending on vowel phoneme and regional variety. Studies testing the perceptual roles of these correlates (Hadding-Koch & Abramson 1964, Behne et al. 1997, Thorén 2003) have arrived at somewhat different conclusions, but agree that duration is the overall most important cue to the quantity contrast, but that the /a/ phoneme ([ɑː]-[a]) and even more the /ʉ/ phoneme ([ʉː]-[ɵ]) depend more on spectrum than the rest of the Swedish vowel inventory.

In a study by Thorén (2003), in which spectral properties were kept intact while both vowel and consonant durations were manipulated in a complementary way, most of the listeners perceived even the /ʉ/ phoneme as non-original quantity type, which was not the case in the study by Hadding-Koch & Abramson (1964). This indicates that the total timing of the VC-sequence, rather than mere vowel duration, can be important for discrimination of /V:C/-/VC:/, and that the listeners in Thorén (2003) may have used the post-vocalic consonant as a complementary cue. However there are confusing conditions since Thorén (2003) used a central standard Swedish speaker, and listeners from all over the Swedish speaking area, while Hadding-Koch & Abramson (1964) used south Swedish speaker and listeners. South Swedish (Skåne dialect) is known for having smaller differences in consonant duration after long and short vowel allophone (Gårding 1974), and moreover other spectral properties for the vowel system than central standard Swedish.

The present study compares two series of vowel duration manipulations; one with changing of vowel durations only, and one with vowel and consonant duration change in combination in accordance with the complementary VC-relation in Swedish. This method could evaluate the consonant duration as a possible complementary cue to the Swedish quantity distinction.

Hypothesis 1: Complementary vowel + consonant duration change helps the listener perceive the non original quantity type with less vowel duration change than change of vowel duration only.

Hypothesis 2: Test words with complementary duration – /V:C/ or / VC:/ – will be judged as more natural sounding than words with "correct" vowel duration and "wrong" consonant duration i.e. /VC/ or /V:C:/.

Method

Stimuli

The test words in the present study are *mäta* [mɛːta] 'to measure', *mätta* [mɛtːa] 'to satisfy' *skuta* [skʉːta] 'boat', *skutta* [skɵtːa] 'to scamper'. These words provide two minimal pairs with respect to phonologic quantity. One pair - contains the vowel phoneme /ɛ/, and the other pair contains the vowel phoneme /ʉ/. The words were recorded in a fairly damped room in the present authors home, using a Røde NT3 condenser microphone and a Sony MZ-N710 mini-disc player. The speaker was a Swedish male speaking central standard Swedish (Stockholm variety). The test words were pronounced within a carrier phrase: *Det var …… jag menade* 'It was ….. that I meant' Vowel and consonant durations in the test words were manipulated in Praat (Boersma & Weenink 2001). All stimuli were given stepwise vowel duration change. Half of the stimuli kept a constant consonant duration, identical with the original quantity type, and the other half were given stepwise consonant duration changes based on original values for non-original quantity type. The manipulated durations are shown in table 1.

Listeners

30 native speakers of Swedish listened to the 48 stimulus words, marking whether they perceived them as /V:C/ or /VC:/. The listeners were between 23 and 60 of age, and had different regional varieties of Swedish as their L1. None of them had any hearing deficiencies that affected their perception of normal speech.

Presentation

The 48 stimuli were presented in random order, in the carrier phrase, preceded by the reading of stimulus number. The test was presented from

Table 1. Vowel- and consonant (occlusion) durations for manipulated stimuli in the present study. Shaded parts represent original durations for non-original quantity type.

Changing of vowel duration only (ms)							
Original	V	188	168	148	128	108	88
[mɛːta]	C	153	153	153	153	153	153
Original	V	136	156	176	196	216	236
[mɛtːa]	C	334	334	334	334	334	334
Original	V	141	121	101	81	61	41
[skʉːta]	C	166	166	166	166	166	166
Original	V	166	186	206	226	246	266
[skɵtːa]	C	312	312	312	312	312	312
Changing of V and C duration (ms)							
Original	V	188	168	148	128	108	88
[mɛːta]	C	234	254	274	294	314	334
Original	V	136	156	176	196	216	236
[mɛtːa]	C	253	233	213	193	173	153
Original	V	141	121	101	81	61	41
[skʉːta]	C	232	252	272	292	312	332
Original	V	166	186	206	226	246	266
[skɵtːa]	C	246	226	206	186	166	146

CD-player via headphones. The listener was first allowed to hear 2-3 stimuli while adjusting the sound level. The response was marked on an answering sheet, presenting the number and the pair of words providing the two choices. The listener had to chose one of the two possibilities. Naturalness rating was done in direct connection to each identification task. After hearing the test word a second time, the listener marked a figure (1-10) on a horizontal 10 cm scale, where 1 represented "totally unnatural or unlikely pronunciation for a native speaker of Swedish" and 10 "totally natural pronunciation for a native speaker of Swedish, regardless of regional variety".

Result

In both the vowel lengthening series and the vowel shortening series, the complementary consonant manipulation seems to have distinct influence on the listeners perception of /V:C/ or /VC:/ (figure 1 and 2). Listeners start to perceive stimuli as non-original quantity type at lower degree of vowel duration change when the post-vocalic consonant duration follows the complementary pattern. For /ʉ/, the complementary manipulation seems to make

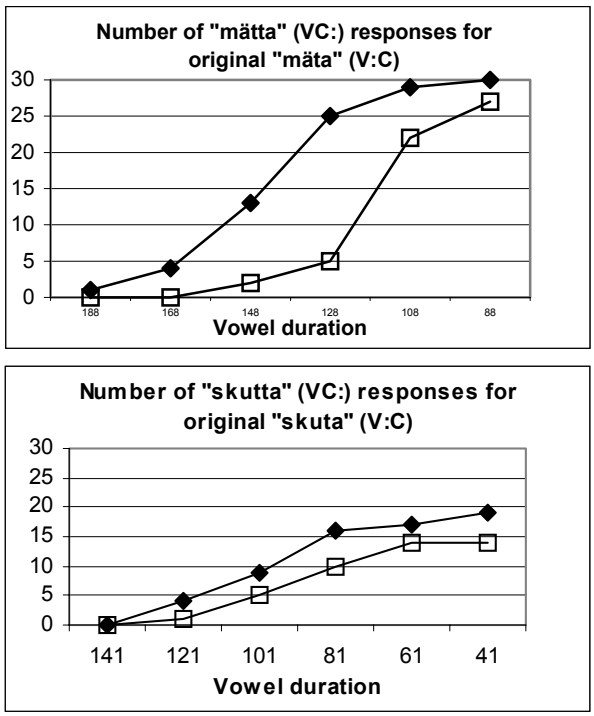

Figure 1. Number of /VC:/-responses for each value of vowel duration in original /V:C/-words. Filled squares represents manipulations of both vowel and consonant durations and open squares represents manipulations of vowel duration only.

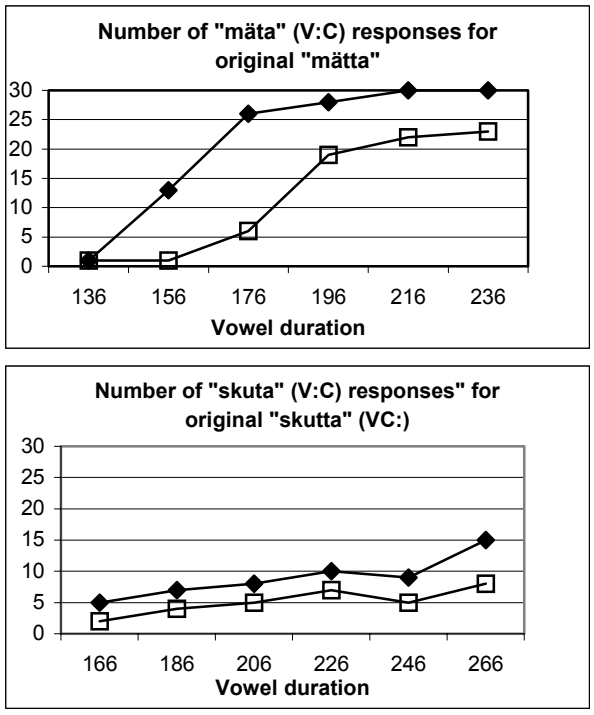

Figure 2. Number of /V:C/-responses for each value of vowel duration in original /VC:/-words. Filled squares represents manipulations of both vowel and consonant durations and open squares represents manipulations of vowel duration only.

less difference compared to /ɛ/, both when going from /V:C/ durations to /VC:/ and vice versa.

The over all effect of duration change is greater for /ɛ/ than for /ʉ/, which is expected, because of the greater difference in formant spectrum between long and short allophone of /ʉ/.

"Correct" consonant duration gave higher naturalness ratings in the two /ɛ/ series, but had a vague effect in the /ʉ/ series. There was a slight positive effect when going from original *skutta* [skɵt:a] to *skuta* [skʉ:ta] , and a small but consistent negative effect when going in the other direction. The observed effect on naturalness from post-vocalic consonant duration in both series containing the /ʉ/ phoneme has low significance, due to the smaller number of "non-original quantity type" responses.

Conclusion

The result shows that the duration of the post-vocalic consonant is more than a means to assign the proper length to stressed syllables. It does obviously play a distinctive role for the perception of quantity type in the present material. Since the involved vowels represent the maximal (/ʉ/) and the minimal (/ɛ/) spectral differences between long and short vowel allophone in the Swedish vowel inventory, the result indicates that the duration of the post-vocalic consonant functions as a general complementary cue to the perception of quantity type in Swedish.

The ambiguous contribution from "correct" consonant duration to naturalness for /ʉ/, can probably be accounted for by the already damaged naturalness caused by changing of durations with intact spectral properties. In the case of /ɛ/, the listeners were probably not disturbed by "incorrect" vowel timbre, and could consequently enjoy the adjusted consonant duration easier.

Since there is already enough evidence for the greater duration of stressed syllables in Swedish, it can be assumed that the duration of the post-vocalic consonant contributes to perception of quantity, word stress and – in most cases – improved naturalness. This in turn makes it reasonable to regard both vowel and consonant duration as important properties when learning Swedish as a second language.

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