Vowel and consonant durations as cues for quantity in Icelandic

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Icelandic distinguishes short and long consonants and vowels in stressed syllables. Phonologically, these show complementary quantity in that a short vowel is followed by a long consonant and vice versa. Perceptual experiments have shown that the ratio of vowel to consonant duration is the major cue for quantity although the vowel spectrum can override the relational cue in those cases where there is a marked difference in the spectral character of the long and short vowels. Measurements are reported of vowel and consonant durations in stressed syllables in words spoken repeatedly in sentence context. The utterances were read at different speaking rates. Two questions are of major interest in this study: 1) To what extent do vowel and consonant durations in different environments support a relational cue for quantity? 2) Is the durational cue weaker in those cases where the spectra of short and long vowels provide another cue for quantity?

INTRODUCTION

The quantity distinction in Icelandic has been investigated by a number of phoneticians (1–2). Icelandic distinguishes short and long consonants in stressed syllables. The quantity distinction is one of complementary duration: A long vowel is followed by one or no consonant whereas a short vowel is followed by a long consonant or a consonant cluster (with some exceptions). This complementary opposition of vowel and consonant duration has turned up quite clearly in perceptual studies where it has been shown that the major cue for quantity is relational, involving the ratio of vowel to rhyme duration (3–6). This is of some importance since such a relational cue provides a putative invariant for the perception of quantity. Since speech segment durations are not only dependent on their inherent phonemic durations but also on such external factors as speaking rate the question arises as to how the listener can keep those apart. Previous experiments (3–4) have shown that the relational cue stays close to invariance under transformations of rate thus solving for the listener the problem of keeping changes of speaking rate from interfering with changes of the phonemic structure of words.

Two complications have recently turned up as regards the role of such a relational invariant. Thus it has been shown that in those cases where the listener is not able to calculate speech segment durations, e.g. because a stop consonant is unreleased, the vowel will in fact become more susceptible to the influence of contextual speaking rate (5). This is as expected. It has also turned out that sometimes the spectral difference between short and long vowels is so great that it will override the durational invariant. This holds e.g. for the vowel [e] in Icelandic, but not for a vowel such as [a] which has similar quality whether long or short (6).

Lindblom (7), in his H&H framework, has hypothesized that speakers are primarily guided by an effort to make themselves understood. Thus one should not expect that speakers always aim for idealized versions of speech segments but rather speak in order to make individual segments sufficiently different so that listeners will not have difficulty understanding their meaning. Such an approach leads to an interesting hypothesis as regards the quantity distinction in Icelandic, namely that the durational distinction will be less clearly demarcated in those cases where vowel quality differences provide another cue for quantity than in those cases where this situation does not hold. The present study compares the quantity distinction in Icelandic words containing the vowels [a] and [e]. The former has very similar formant patterns in the short and long varieties whereas the latter shows appreciable differences in the short and long phonemes.

METHOD

The words investigated in this study were the following: 1) seki, 'guilty', (adj. sg. masc.); 2) seggi, 'fellow' (noun pl. acc.); 3) saki, 'to suffer' (verb 3rd pers. subj.); 4) saggi, 'damp', (noun nom. sg.). These words were embedded in a connected text, resembling a spelling exercise familiar to all Icelandic students, containing a number of sentences, not necessarily thematically connected. This text contained a total of 163 words. The target words were always the first words in each sentence. A few sentences came between the target sentences to lessen the likelihood that the readers would pay more attention to the target words than any other words in the sentences. They were not told that some words had special status in regard to this study. Twenty five undergraduate students at the University of Iceland took
part in the study reading the text twice at a fast, normal and slow rate. All students started reading the text at the normal rate with half then reading at the fast rate followed by the slow rate and the other way round for half the participants. Durational measurements were carried out using the Sensimetrics SpeechStation and its accompanying software.

RESULTS AND DISCUSSION

The figure shows the results of the durational measurements for both vowels. Evidently the pattern of results is quite similar in both cases. Calculating the V/(V+C) ratios for these data shows that it averages 0.59 for words with a long [a] and 0.34 for short [a] words. For the words containing the vowel [e] the respective values are 0.57 and 0.24. If in fact the durational distinction is less well established in the [e]-words it would be hypothesized that the difference of the V/(V+C) ratios in the words containing long and short vowels would be less for the words containing the vowel [e]. This, however, is not the case. The difference amounts only to 0.004, which is not statistically significant, t(296) = 0.32. The “optimal” boundary for both vowel sets lies at a V/(V+C) ratio of 0.50. This boundary leads to misclassification of 16 out of 300 tokens of words containing [a] and misclassification of 15 out of 300 tokens of words containing the vowel [e]. Again, the pattern of results is similar for both types of words.

![Graph](image)

**FIGURE 1.** Vowel and closure durations in words containing the vowel [a] and [e]. Each figure shows 300 measurements.

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REFERENCES