

# Stress, Accent and Vowel Durations in Finnish

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## Abstract

*The paper summarises recent research on the interaction of prominence and vowel durations in Finnish, a language with fixed initial stress and a quantity opposition in both vowels and consonants; to be more accurate, the research has been conducted on Northern Finnish. It is shown that, in one-foot words, there are four statistically distinct, non-contrastive duration degrees for phonologically single vowels, and three such degrees for phonologically double vowels. It is shown that the distributions of these duration degrees are crucially determined by moraic structure. Also sentence accent has a moraic alignment, with a tonal rise occurring on the word's first mora and a fall on the second mora. It is argued that the durational alternations are motivated by the particular way in which accent is realised.*

## 1 Introduction

In Finnish word stress is invariably associated with the initial syllable, and there is a binary quantity opposition in both vowels and consonants, independent of stress, effectively signalled by only durational differences. There are very good grounds for interpreting the quantity oppositions syntagmatically, as distinctions between a single phoneme and a double phoneme, i.e. a sequence of two identical phonemes (Karlsson, 1969). This interpretation is also reflected in the orthography, and thus there are written words like *taka*, *taaka*, *takka*, *taakka*, *takaa*, *taakaa*, *takkaa*, *taakkaa*. However, the orthography only indicates the contrastive, phonemic quantity distinctions and, beyond this, it does not in any way reflect the actual durations of phonetic segments. Thus, for example, the orthography or a phonemic transcription do not in any way express the fact that, in e.g. the dialect discussed in this paper, the second-syllable single vowel in *taka* has a duration that is almost twice as long as that in *taaka*, *takka* and *taakka*. This paper summarises recent research on such non-contrastive vowel duration alternations, and suggests their motivations. The paper only looks at vowel durations, and only in words that consist of just one, primary-stressed foot, and thus the effect of secondary stress on vowel durations, which has not been systematically examined, is excluded.

As will be seen below, the mora is an important unit in Finnish prosody. The morae of a syllable are counted as follows: the first vowel phoneme – the syllable nucleus – is the first mora, and every phoneme segment following in the same syllable counts as an additional mora. Below, reference will be made to a word's morae, and e.g. the words *taka*, *taaka* and *taakka* have the moraic structures  $CM_1.CM_2$ ,  $CM_1M_2.CM_3$  and  $CM_1M_2M_3.CM_4$ , respectively (where  $M_n$  refers to the word's  $n^{\text{th}}$  mora, and C is a non-moraic consonant).

## 2 Vowel duration patterns

Suomi & Ylitalo (2004) investigated segment durations in unaccented, trisyllabic nonsense words that consist of one foot each. The segmental composition of the nonsense words was

fully counterbalanced. The word structures investigated were CV.CV.CV, CV.CVC.CV, CV.CVV.CV, CV.CVV.CVV, CVC.CV.CV, CVC.CVC.CV, CVV.CV.CVV and CVV.CVV.CVV, each represented by 18 different words. The words were spoken in the frame sentence *xyz, MINUN mielestäni xyz kirjoitetaan NÄIN (xyz, in MY opinion xyz is written like THIS)*, where *xyz* represents the target word, the second occurrence of which was measured. The five speakers were instructed to emphasise the capitalised words. Suomi & Ylitalo only compared segment durations within the domain of the word's first two morae with those outside the domain, but the data have now been reanalysed in more detail. It turned out that there are four statistically distinct, non-contrastive and complementary duration degrees for single vowels, denoted as  $V_{(1)} - V_{(4)}$  in Table 1. The Table also shows the results for three classes of double vowels (VV) with different moraic affiliations. The duration labels given to the duration degrees are *ad hoc*.

**Table 1.** The mean durations (in ms) of the four duration degrees (DD) of phonologically single vowels (V) and of three types of double vowels (VV) as observed in Suomi & Ylitalo (2004) and in Suomi (in preparation); columns S & Y and S, respectively. In the column Moraic status " $\underline{M}_{3+}$ " means that the V is the word's third or later mora, " $\underline{M}_1$ ." that the V is  $M_1$  that is followed by a syllable boundary, " $\underline{M}_1C$ " that the V is  $M_1$  that is followed by a consonant in the same syllable, " $\underline{CM}_2$ " that the V is  $M_2$  preceded by a consonant in the same syllable, " $\underline{M}_1\underline{M}_2$ " that the VV constitutes the sequence  $M_1M_2$ , " $\underline{M}_2\underline{M}_3$ " that the VV constitutes the sequence  $M_2M_3$ , and " $\underline{M}_{3+}\underline{M}$ " that the first segment in the VV sequence is  $M_{3+}$  or a later mora. For further explanations see the text.

DD	Duration label	S & Y	S	Moraic status	Example structures
$V_{(1)}$	"extra short"	48	75	$\underline{M}_{3+}$	CV.CV.CV, CVC.CV
$V_{(2)}$	"short"	58	104	$\underline{M}_1$ .	CV.CV(X)
$V_{(3)}$	"longish"	73	126	$\underline{M}_1C$	CVC.CV(X)
$V_{(4)}$	"long"	84	158	$\underline{CM}_2$	CV.CV(C)
$VV_{(1)}$	"longish" + "longish"	149	-	$\underline{M}_1\underline{M}_2$	CVV(X)
$VV_{(2)}$	"long" + "extra short"	142	-	$\underline{M}_2\underline{M}_3$	CV.CVV
$VV_{(3)}$	"very long"	135	-	$\underline{M}_{3+}\underline{M}$	CVC.CVV, CVV.CVV

Suomi (in preparation) measured durations in segmentally fully controlled, accented CV.CV and CVC.CV nonsense words embedded in the frame sentence *Sanonko \_\_\_ uudelleen? (Shall I say \_\_\_ again?)* and spoken by seven speakers. Suomi found the same four statistically distinct duration degrees for phonologically single vowels, as reported in Table 1. Three of the four single vowel duration degrees have been well documented earlier, e.g. by Lehtonen (1970), but the existence of degree  $V_{(3)}$  ("longish") has not been previously reported.

Below are the distributional rules of the observed duration degrees. The rules are to be applied in the following manner: if a word contains a VV sequence, then an attempt to apply the rule for VV duration should be made first. If this rule is not applicable, then the rule for V should be applied to both members of the VV sequence (and of course to singleton V's).

- VV → [very long] if the first V in the sequence constitutes  $M_{3+}$   
V → [extra short] if it constitutes  $M_{3+}$   
→ [short] if it constitutes  $M_1$  that is not next to  $M_2$   
→ [longish] if it occurs in the sequence  $M_1M_2$   
→ [long] if it constitutes  $M_2$  that is not next to  $M_1$

As the rule for VV duration is formulated, it is only applicable to VV<sub>(3)</sub> but not to VV<sub>(1)</sub> nor to VV<sub>(2)</sub>. In these latter two cases, then, the rule for V duration has to be separately applied to both segments in the sequence, and the correct durations are assigned. Thus VV is “very long” in e.g. CVV.CVV.CVV and CVC.CVV, V is “extra short” in e.g. CVV.CV, CVC.CV and CV.CV.CV, “short” in CV.CV(X), “longish” in CVC.CV and CVV.CV (both segments in VV are “longish”), and “long” in CV.CV. In the structure CV.CVV, the first segment in the second-syllable VV sequence (M<sub>2</sub>) is analysable as “long” and the second one (M<sub>3</sub>) as “extra short”; the sum of these duration degrees is (84 ms + 48 ms =) 132 ms which is 10 ms less than the observed duration for VV<sub>(2)</sub> (142 ms), but the difference was not significant. The durational alternations under discussion of course entail complications to the realisation of the phonemic quantity opposition, and in particular the durational difference in the second-syllable vocalic segments in CV.CV and CV.CVV word structures is less than optimal.

Notice that the above rules explicitly refer to moraic structure only, and not e.g. to the syllable. Notice further that M<sub>3+</sub> is only referred to when the vowel is either “very long” or “extra short”. These degrees represent the durations of double and single vowels in those unstressed syllables in which nothing interferes with the realisation of the quantity opposition; in these positions, the mean duration of double vowels is (135/48 =) 2.8 times that of single vowels. But when a vowel constitutes M<sub>1</sub>, it can be either “short” or “longish”, and when it constitutes M<sub>2</sub>, it can be either “longish” or “long”. This is because the durations of these segments also signal prominence.

### 3 On the phonetic realisation of prominence

The distinction drawn by Ladd (1996, and elsewhere) between the association and the alignment of prominence is very useful in Finnish. Primary word stress is unquestionably phonologically associated with the word’s initial syllable, but its phonetic alignment with the segmental material is more variable. Stress is signalled by greater segment duration, but not necessarily on the stressed syllable only. Broadly speaking, stress is manifested as greater duration of the segments that constitute M<sub>1</sub> and M<sub>2</sub>, but exactly how the greater duration is distributed depends on the structure of the initial syllable. If the initial syllable is light, i.e. in (C)V.CV(C) words, the first-syllable vowel is “short” and the second-syllable vowel (M<sub>2</sub>) is “long” (but both are longer than the third-syllable “extra short” vowel in (C)V.CV.CV(C) words). But if the initial syllable is heavy, i.e. contains both M<sub>1</sub> and M<sub>2</sub>, then both of these segments are “longish” as in CVV.CV(C) words (and the second-syllable V is “extra short”).

As concerns sentence accent, it is normally realised as a tonal rise-fall that is also moraicly aligned: the rise is realised during the first mora, and (most of) the fall during the second mora. Thus in (C)V.CV(C) words, the rise is realised during the first syllable and the fall during the second one, whereas in words with a heavy initial syllable both the rise and the fall are realised during the initial syllable. Strong (e.g. contrastive) accent involves a wider f<sub>0</sub> movement than moderate accent, and it is also realised durationally, as an increase in the durations of especially M<sub>1</sub> and M<sub>2</sub>. But moderate accent is not realised durationally, i.e. the unaccented and moderately accented versions of a word have equal durations.

In many languages, details of the tonal realisation of accent depend on the structure of the accented syllable. Thus e.g. Arvaniti, Ladd & Mennen (1998) report that, in Greek, the slope and duration of the (prenuclear) accentual tonal movement vary as a function of the structure of the accented syllable. This is not so in Finnish. Instead, what has been observed repeatedly is that, given a constant speech tempo and a given degree of accentuation, the rise-fall tune is temporally and tonally uniform across different word and syllable structures (Suomi, Toivanen & Ylitalo, 2003; Suomi, 2005; in press).

#### 4 Motivating the durational alternations

Why are there so many non-contrastive vowel duration degrees in Finnish, alternations that partly interfere with the optimal realisation of the quantity opposition? The answer seems to be provided by the particular combination of prosodic properties in the language. Given the uniformity of the accentual tune across different word structures, and given the moraic alignment of the accentual tune, the durational alternations discussed above are necessary. If the durational alternations did not exist but accent nevertheless had the moraic alignment that it has, the uniformity of the accentual tune would not be possible. Why the tonal uniformity exists is not clear, but there it is. It is somewhat paradoxical that, in a full-fledged quantity language in which segment durations signal phonemic distinctions, segment durations nevertheless also vary extensively to serve tonal purposes, while in non-quantity languages like Greek the segmental composition of the accented syllable determines the tonal realisation.

The durational alternations are also observable in unaccented words. But this does not undermine the motivation just suggested, because unaccented and moderately accented words do not differ from each other durationally, and the alternations are directly motivated in moderately accented words. Thus unaccented words are as if prepared for being accented. A conceivable alternative would be that unaccented words would lack the alternations present in accented words, but this state of affairs would further complicate the durational system.

To summarise, beyond the loci in which stress and accent are realised, i.e. when vowels do not constitute  $M_1$  or  $M_2$ , single vowels are “extra short” and double vowels “very long”, which results in their clear separation. In (C)V.CV(X) words, the tonal rise is realised during the initial syllable and it is sufficient that the vowel is “short”. The long fall is realised during the second syllable, and therefore the vowel must be “long”. In (C)VV.CV(X) words, both the rise and most of the fall is realised during the initial syllable, and therefore both segments in the VV sequence must be “longish”. This paper is not about consonant durations but in (C)VC.CV(X) words, in which  $M_2$  is a consonant, it too has to be “longish”; if the consonant has relatively short intrinsic duration elsewhere, it is lengthened in this position. As a consequence of these alternations, the accentual rise-fall can be uniform across different word structures, and at the same time, the quantity oppositions are not jeopardised.

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