

# Three-way opposition of consonant quantity in Finnic and Saamic languages

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## Abstract

This paper focusses on the ternary contrast of consonant duration in three Finnic languages and Inari Saami. We show that the ternary contrast is found not only in Estonian and the Saami languages, but also in two minor Finnic languages, namely Livonian and Ingrian. All four languages observed in the paper differentiate between single consonants, short geminates, and long geminates. The three-way opposition is manifested only on the boundary of a stressed and unstressed syllable. We study comparatively the correlations between the duration of the three types of consonants and the surrounding vowels in the four languages. It appears that in all languages the duration of the first syllable vowel is not influenced by the intervocalic consonant duration, while the duration of the second syllable vowel is inversely related to the duration of the consonant. Finally, we show that there are some differences in the ratio between levels of consonant length in these languages.

## 1. Introduction

As noted in a number of typological studies, three-way length contrasts are extremely rare in world languages (Ladefoged & Maddieson, 1996; Blevins, 2004; McRobbie-Utasi, 2007; Remijsen & Gilley, 2008; Prehn, 2011). About a dozen languages are reported to have three distinctive lengths for vowels, and only Estonian and Saamic languages are usually claimed to have a ternary length contrast of consonants.

In our paper we focus on the ternary contrast of consonants in three Finnic languages and Inari Saami. Our first aim is to show that there are more examples of ternary consonant lengths in Finno-Ugric languages by presenting data from two lesser studied Finnic languages, Livonian and Ingrian. We are going to provide acoustic evidence for the presence of a three-way length contrast in Livonian and Ingrian supported by statistical analysis. Next, we will study comparatively the correlations between the duration of the three types of consonants and the surrounding vowels in Estonian, Livonian, Ingrian, and Inari Saami. In all these languages, the three-way opposition is manifested only on the boundary of a stressed and unstressed syllable; hence it is essential to study the relations of segments in the foot. Finally, we will point out similarities and differences between the languages.

It has been suggested that the phonetic distinction between short and long geminates occurred already in late proto-Finnic (cf. Lehtinen, 2007: 148–149).

The distinction between short and long geminates appeared on the border of the stressed and unstressed syllable and was dependant on the structure of the unstressed syllable – the geminate was shortened when the syllable was closed.

This distinction was preserved in the southern group of Finnic languages (Pajusalu, forthcoming), but got neutralised in the northern group. In Estonian and Livonian, short and long geminates appear synchronically after short vowels both before open and closed syllables, e.g. Estonian Q2 *sepa* [seppa] ('smith', gen.sg), Q3 *seppa* [sep:pa] ('smith', part.sg); Livonian *sipā* [sippa] ('drop', nom/gen.sg), *sippõ* [sip:pɤ] ('drop', part.sg)<sup>1</sup>. In Estonian, the distinction is also present after long vowels, e.g. Q2 *saate* [sa:tte] ('get', prs.2pl), Q3 *saate* [sa:t:tte] ('broadcast', gen.sg). The opposition between short and long geminates became phonologically distinct, and long and overlong quantities started to distinguish between grammatical forms.

The opposition of short and long geminates did not develop only from primary geminates, but could also have occurred as a late gemination of single consonants before a long vowel or diphthong of the second syllable, cf. South Estonian Q2 *kalla* [kalla] ('fish', part.sg) (< \**kalata*), Q3 *kalla* [kal:la] ('fish', ill.sg) (< \**kalahen*).

In a similar way, short geminates also developed from single consonants in Ingrian dialects. In Soikkola Ingrian, the ternary contrast of consonants is found both after long and short vowels, cf. *tapa* [tapa] ('kill', imp.2sg), *tappaa* [tappa:] ('be.enough', cng), *tappaa* [tap:pa:] ('kill', prs.3sg); *saataa* [sa:ta:] ('send', imp.2sg), *saattuu* [sa:ttu:] ('garden', ill.sg), *saattaa* [sa:t:ta:] ('send', inf). In the VCV foot (*tapa* 'kill', imp.2sg) the second vowel can be interpreted both as short and long, because there is no contrastive structure in Ingrian that would provide a context for a phonological opposition (see Markus, 2011: 109–110 for a detailed discussion). This foot type is similar to the same structures in Estonian and Livonian where the vowel duration is not phonologically contrastive in unstressed syllables at all.

In Inari Saami, short and a long geminates occur both after short and long vowels, e.g. *koļe* [kolle] ('gold', gen/acc.sg), *kolle* [kol:le] ('gold', nom.sg); *táálu* [tæ:llu] ('house', nom.sg), *táállun* [tæ:l:lun] ('house', ess.sg). However, in the last structure the second syllable is always closed. The vowel duration is contrastive also in unstressed syllables in Inari Saami, cf. *palloon* [pal:lo:n] ('fear', ess.sg).

<sup>1</sup> For all the examples in this paper we provide both the orthographic variant and the IPA transcription. As there is no orthography for Ingrian, we use the Finnish spelling.

## 2. Data and methods

In this paper we are investigating disyllabic words with a short first vowel. It was not possible to get entirely comparable data sets for all four languages, and therefore this research should be treated as a pilot study that reveals basic regularities and differences between the four languages.

The Estonian data were recorded in 2007. There were 12 male speakers born in 1961–1986 (the average age was 28 years). One set of words contained intervocalic /t/ and another intervocalic /l/. The test-words were read in carrier sentences where they were in the sentence-medial position (e.g. *piima kalla mannergust* [pi::ma kal:la mannerkust] ‘pour milk from a milk can’). There were 10 repetitions for each foot structure and for both intervocalic consonants, thus  $10 \times 3 \times 2 = 60$  tokens from each speaker. Some misread words were left out from the analysis.

The Livonian data were recorded in 2004 from 8 Livonian speakers (6 female, 2 male, belonging to three generations, born in 1914–1921, in 1950–1970, and in 1978–1990; see Lehiste et al., 2008). Two speakers from the oldest generation spoke Livonian as their mother tongue; the rest have acquired Livonian in their childhood (L1 being Latvian). The words were read in carrier sentences where they were in the phrase-final and sentence-final position (e.g. *ma äb pietā, äb vöi piētõ* [ma æp pietta | æp vxi piet:tɤ] ‘I don’t deceive, (I) can’t deceive’; see lists of test-words in Lehiste et al., 2008: Appendix 2 and 3). The same measurements of sound durations were used as in Lehiste et al. (2008), but phrase- and sentence-final words were analysed together, and words containing a short first vowel and short diphthongs were combined into one structure.

A male speaker HM of Inari Saami (aged 77) was recorded in 2012. Disyllabic test words were placed in carrier sentences in phrase-final, sentence-medial, and sentence-final positions: e.g. *must lii ... , tust láá ...* [mus:t li: ... | tus:t læ: ...] ‘I have ..., you have ...’; *ââďâ ... munjin* [ɤ:ðɤ ... munjin] ‘say ... to me’, *ââďâ ... aalmai* [ɤ:ðɤ ... al:mái] ‘say ... to the man’. For each phrase position there were 9 repetitions for words with the VCV structure, 6 repetitions for the VCCV structure and 10 repetitions for the VC:CV structure; in total 75 tokens. To minimise the risk of generalising idiomatic features when basing the whole description on only one speaker, this data is compared and combined with the data reported in Sagulin (2008; see also Bye et al., 2009). Their data was recorded from 5 native Inari Saami speakers (3 female and 2 male speakers, age 60–70 years). The words were read in the sentence-medial position in the same carrier phrases as above (read more about the recording procedure in Bye et al., 2009: 203–204).

Figure 1 shows comparatively the average duration of the first vowel, second consonant and second vowel in three foot structures in the data by HM and from Sagulin (2008). Words from different phrase positions were pooled together. Despite differences in the duration of the segments, both datasets are displaying similar patterns, and in further analysis we have combined the data from all 6 speakers.

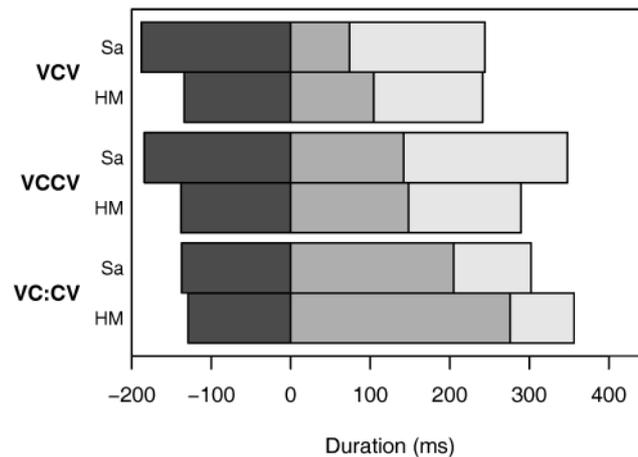


Figure 1: The duration of the first vowel (dark grey bar), intervocalic consonant (medium grey bar) and second vowel (light grey bar) in milliseconds in three foot structures in Inari Saami as produced by the speaker HM and in the data from Sagulin, 2008 (Sa).

The Ingrian data were recorded in 2010 from 2 female speakers of Soikkola Ingrian born in 1927 and 1932 (for details see Markus, 2011). The test words with intervocalic stops (*k*, *t*, or *p*) were placed in carrier phrases in phrase-final and sentence-final positions (e.g. *kiukkaas on va rokka, miulle ei tappaa* [kiukka:z on va rok:ka | miul:le ei tappa:] ‘In the oven there is only soup, it is not enough for me’). For each sentence position there were 5 words of the VCV and VC:CV structures and 6 words of the VCCVV and VC:CVV structures, thus 44 tokens from each speaker.

The overview of the dataset is given in Table 1. In the analysis we pooled words from different sentence positions together.

Table 1: Examples of test words and the number of tokens analysed in the four languages.

Language	Number of speakers	Structure	Number of tokens	Examples
Estonian	12	VCV	240	<i>sada</i> [sata] ('hundred', nom.sg)
		VCCV	237	<i>mata</i> [matta] ('bury', imp.2sg)
		VC:CV	240	<i>matta</i> [mat:ta] ('bury', inf)
Livonian	8	VCV	57	<i>kudā</i> [kuda] ('knit', imp.2sg) <sup>2</sup>
		VCCV	61	<i>sutā</i> [sutta] ('wolf', part.sg)
		VC:CV	87	<i>kattō</i> [kat:tr] ('cover', inf)
Inari Saami	6	VCV	115	<i>palo</i> [palo] ('fear', gen/acc.sg)
		VCCV	163	<i>paļo</i> [pallo] ('fear', nom.sg)
		VC:CV	241	<i>kallu</i> [kal:lu] ('forehead', nom.sg)
Ingrian	2	VCV	20	<i>tapa</i> [tapa] ('kill', imp.2sg)
		VCCVV	24	<i>tappaa</i> [tappa:] ('be.enough', cng)
		VC:CV	20	<i>kukka</i> [kuk:ka] ('flower', nom.sg)
		VC:CVV	24	<i>tappaa</i> [tap:pa:] ('kill', prs.3sg)

### 3. Results and discussion

#### 3.1. Ternary length distinction and relations of segments in the foot

In this section we study comparatively the duration of the stressed syllable vowel (V1), intervocalic consonant (C), and unstressed syllable vowel (V2) in the four languages. We also examine the effect of the consonant duration on the duration of the first and second vowel. In order to verify whether the difference between the durations is statistically significant, we performed a single-factor ANOVA testing the effect of the foot structure (3 or 4 levels depending on the language) on the segment duration. In cases where significant difference was observed, we used post-hoc tests (Tukey HSD) to point out pairwise combinations that demonstrate the difference.

Figure 2 plots the average duration of the first syllable vowel, intervocalic consonant and second syllable vowel in three contrastive structures for Estonian, Livonian, Inari Saami, and in four structures for Ingrian. The durations are aligned by the beginning of the intervocalic consonant. In all languages, V1 is short, and C is a single consonant, a short geminate or a long geminate. In Inari Saami, we analysed only the structures with a short V2, while in Ingrian we took structures with both short and long V2 after a long geminate, and thus four structures instead of three in other languages were compared.

<sup>2</sup> In Livonian, there is no voiced-unvoiced contrast for single stops, and they are always pronounced as voiced in the intervocalic position.

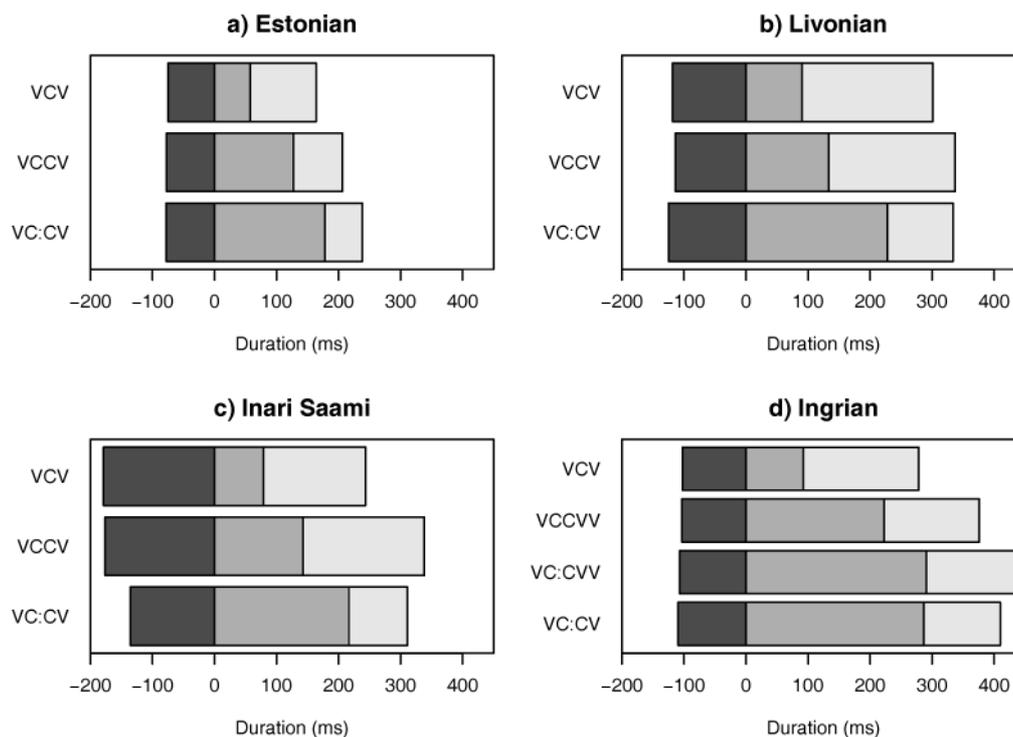


Figure 2: The duration of the first syllable vowel (dark grey bar), intervocalic consonant (medium grey bar) and second syllable vowel (light grey bar) in milliseconds in the four languages.

In Estonian, the duration of the intervocalic consonant was significantly different between the foot structures [ $F(2, 33)=98.376$ ;  $p<0.001$ ], while post-hoc testing showed a significant difference between all consonant quantities at  $p<0.001$ . The variation of the intervocalic consonant did not affect V1 duration in this word structure [ $F(2, 33)=0.182$ ;  $p=0.834$ ], but there was a significant variation in V2 duration [ $F(2, 33)=33.15$ ;  $p<0.001$ ] which was the longest after a single consonant ( $p<0.001$  Q1 vs. Q2 and Q3) and shortest after a long geminate ( $p<0.01$  Q3 vs. Q2).

For the Livonian data, an ANOVA showed that the difference in the duration of different consonant types was highly significant [ $F(2, 21)=53.671$ ;  $p<0.001$ ] (a short consonant was significantly shorter than a short geminate at  $p<0.05$ , and a long geminate was significantly longer than a short geminate consonant at  $p<0.001$ ). The duration of the short V1 did not vary significantly [ $F(2, 21)=0.257$ ;  $p=0.776$ ], but there was a significant variation in V2 duration [ $F(2, 21)=27.415$ ;  $p<0.001$ ]. Similarly to Estonian, V2 duration had an inverse tendency to C duration, but post-hoc test showed a significant difference only between the duration of V2 after single consonants and short geminates vs. long geminates at  $p<0.001$ . The difference between the duration of V2 after single consonants and short geminates was not significant.

In Inari Saami, the difference in the C duration between word structures was significant [ $F(2, 15)=21.522$ ;  $p<0.001$ ] being significant between C and CC at  $p<0.05$  and between CC and C:C at  $p<0.01$ . Again, there was no significant variation in V1 duration [ $F(2, 15)=0.843$ ;  $p=0.45$ ]. The variation in V2 duration was nearly significant [ $F(2, 15)=5.963$ ;  $p=0.012$ ], but the pattern was unexpected, V2 being the longest after short geminates and shortest after long geminates with single consonants in between. Post-hoc tests showed that the difference was only significant between structures with short and long geminates at  $p<0.01$  level and not significant between other combinations.

In Ingrian, the effect of the word structure was significant for the C duration [ $F(3, 4)=71.574$ ;  $p<0.001$ ], but post-hoc test showed that the difference was significant in the following combinations (post-hoc VC:CVV-VC:CV NS; VCCVV-VC:CV  $<0.05$ ; VCV-VC:CV  $<0.001$ ; VCCVV-VC:CVV  $<0.05$ ; VCV-VC:CVV  $<0.001$ ; VCV-VCCVV  $<0.005$ ). Unlike in other languages, in Ingrian the word structure had no effect either on V1 duration [ $F(3, 4)=0.041$ ;  $p=0.987$ ] or V2 duration [ $F(3, 4)=2.637$ ;  $p=0.186$ ]. This result is unexpected, since the V2 duration is clearly much bigger in the VCV foot than in all other structures. A new study with more speakers and tokens involved is needed to clarify whether the word structure has any effect on the duration of V2 in Ingrian.

As seen both from Figure 2 and the ANOVA results, in all languages the duration of V1 did not depend on the foot structure. The average durations of V1 were very similar.

In all languages, except Ingrian, the ANOVA tests showed a considerable effect of the foot structure on the duration of V2. Figure 3 shows the proportions of the consonant and the second vowel relative to the duration of these two segments together. It is clearly seen that in all four languages the consonant and the second vowel are inversely related: the longer the consonant the shorter the vowel. The pattern is also relevant for Ingrian, although the differences in the duration of V2 in different foot structures turned out to be not statistically significant.

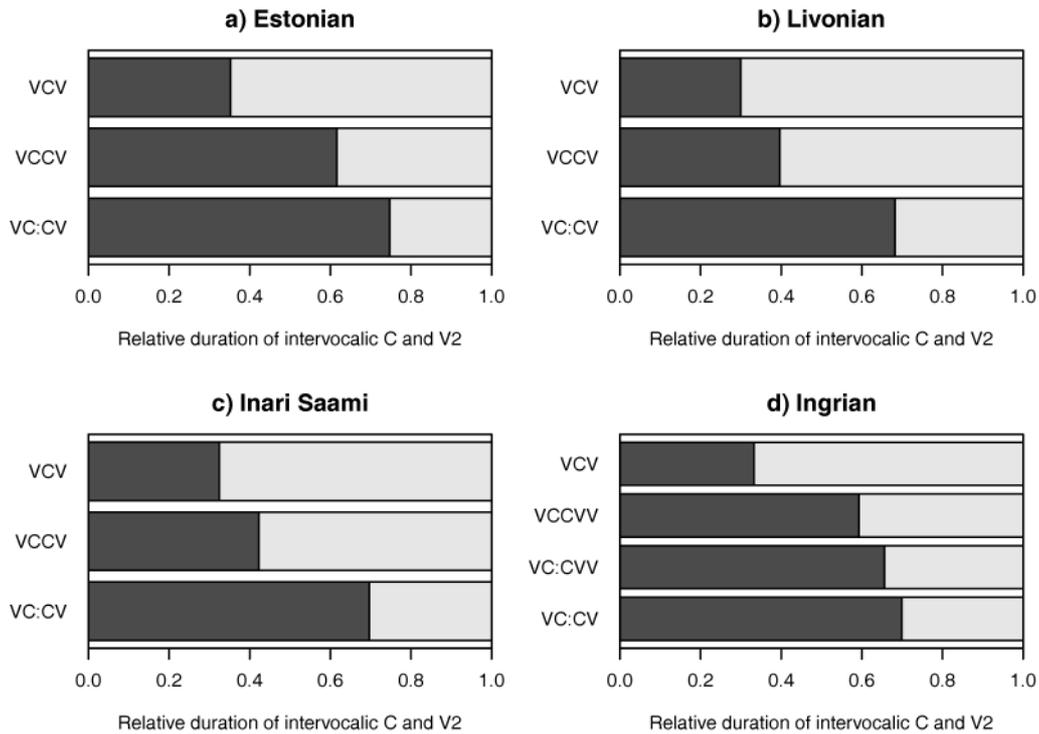


Figure 3: The duration of the consonant (dark grey bar) and second vowel (light grey bar) relative to the duration of C+V2.

### 3.2. The ratio between levels of consonant length

It is widely accepted that in languages with a binary contrast of consonants the average ratio of a geminate to a single consonant is roughly two to one. For instance, in Finnish this ratio is 1.83 (Suomi et al., 2008: 90).

Table 2 gives the ratios of a short geminate to a single consonant, and a ratio of a long to a short geminate in the four languages with a ternary contrast of consonants that we are investigating in this paper.

Table 2: The ratios of a short geminate to a single consonant, and a long to a short geminate in the four languages.

	CC / C	C:C / CC
Estonian	2.19	1.40
Livonian	1.49	1.78
Inari Saami	1.81	1.52
Ingrian	2.42	1.30

It is noticeable that Estonian, Inari Saami, and Ingrian keep the ratio between the first two consonant lengths similar to the average ratio between consonant lengths in binary systems (it is around or more than two to one). At the same

time, in these three languages the distance between the second and third lengths is considerably smaller (from 1.3 to 1.52 in our data).

On the other hand, in Livonian, the ratio between the first two consonant lengths is smaller (1.49), while the short and long geminates are spaced at a bigger distance (the ratio is 1.78).

#### 4. Conclusions

A ternary contrast of consonants is found not only in Estonian and Saami, but also in some minor Finnic languages. In this paper we provided acoustic evidence for the presence of the ternary contrast also in Livonian and Ingrian. All four languages differentiate between single consonants, short geminates, and long geminates, but the three-way opposition is manifested only on the boundary of a stressed and unstressed syllable.

In Estonian, Livonian, Inari Saami, and Ingrian, the duration of the first syllable vowel is not influenced by the duration of the following consonant.

In all four languages, the duration of the second syllable vowel is inversely related to the duration of the intervocalic consonant (the longer the consonant, the shorter the vowel). Statistically, the difference in the duration of V2 is only significant in Estonian, Livonian, and Inari Saami, while in Ingrian the tests showed no effect of the duration of a preceding consonant on V2 duration. However, in case of Ingrian the results of the statistical tests should be treated with caution and rechecked on a larger data set.

In Estonian, Livonian, and Inari Saami, the second syllable vowel is significantly shorter after a long geminate than after a short geminate. In Livonian and Inari Saami, there is no significant difference in the duration of V2 after a short geminate vs. a single consonant. In Estonian, the duration of V2 after a short geminate is significantly shorter than after a single consonant.

The three consonant durations are not equally spaced in the four languages. In Estonian and Ingrian, the ratio between a single consonant and a short geminate is comparable to the ratio between a single consonant and a geminate in languages with a binary contrast (roughly two to one). At the same time, the distance between short and long geminates is considerably smaller. In Livonian, the ratio between a single consonant and a short geminate is smaller than the ratio between short and long geminates. In Inari Saami the ratios are closest to Estonian but there were big differences between idiolects which indicates the need for a more extensive study of the ternary quantity opposition in this language.

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