TEMPORAL PATTERNS OF QUANTITY IN INARI SAAMI

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ABSTRACT

The sound system of Inari Saami exhibits a three-way quantity contrast which is similar to some other Finno-Ugric languages – Estonian and Livonian – in several respects. In all these languages the domain of ternary quantity is a disyllabic foot where the first syllable is stressed and the second syllable is unstressed. In this study we investigate the realisation of the ternary quantity contrast in Inari Saami disyllabic words with phonologically short and long vowels or diphthongs as the nucleus of the first syllable. Our results show that in consonant duration the ternary distinction occurs after a short vowel. The opposition is binary after a short diphthong (consonant is either short or long) and after a long vowel or a long diphthong (consonant is either short or half-long). A vowel in the unstressed second syllable compensates for the length of the preceding vowel and consonant within the foot.

Keywords: three-way quantity contrast, word prosody, Inari Saami, Finno-Ugric languages

1. INTRODUCTION

The ternary quantity contrast is a phonological feature which appears in several Finno-Ugric languages, such as Estonian, Livonian, and Northern Saami [8, 13]. It is also found in Inari Saami, an indigenous language, belonging to the eastern group of Saami languages and spoken by about 250 mostly elderly native speakers around Lake Inari in Northern Finland [6]. In Inari Saami, the ternary quantity distinction is primarily manifested in consonant duration which is realised by the opposition of single consonants, short geminates (also called half-long) and long geminates, or consonant clusters [9, 14]. The three-way quantity contrast for consonants is not found in all parts of Saami language area; besides Inari Saami it has been described in Lule, North, and Skolt Saami [4, 5, 10, 11].

Unlike consonants the vowels of Inari Saami are either short or long [12]. In stressed syllables, both short and long vowels occur; in unstressed syllables, there are only phonologically short vowels [7]. In addition to monophthongs, Inari Saami also has short and long diphthongs in stressed syllables [3, 12]. Thus, there are various disyllabic foot structures containing combinations of short or long monophthongs and diphthongs, single consonants or short or long geminates and consonant clusters.

Earlier studies have shown that segments in Inari Saami disyllabic foot are interrelated. In words with a phonologically short vowel in the first syllable it has been found that the following consonant has three degrees of length, and with the increase in consonant quantity the durations of the surrounding vowels decrease preserving the equal duration of the feet in all three quantity degrees. [4, 14] After a long vowel in the first syllable there is no clear three-way distinction in consonant duration [4].

The aim of the present research is to study how the ternary contrast of consonantal quantity is realised in the case of foot structures that have short and long vowels or diphthongs as the nucleus of the first syllable. Here we call short and long geminates respectively half-long and long consonants.

2. MATERIALS AND METHOD

Our Inari Saami data of four male native speakers was collected in 2013 using an Edirol R-09 digital recorder at 48 kHz, 16 bit PCM. The subjects were 62, 68, 76 and 77 years old. Besides their native language, three of the subjects also have a good knowledge of North Saami and all four subjects speak Finnish.

The subjects were asked to read the test words embedded in the phrase-medial or phrase-final position of a carrier sentence, e.g. *Ohtâ **maṇe** lii taa, mut ohtâ **lodde** lii tobbeen* ‘Here is one **egg**, but there is one **bird**’; *Mist láá kuttâ **sare**, mut sist láá kuttâ **juuŋâ*** ‘We have six **blueberries**, but they have six **lingonberries**’. In this paper we analyse disyllabic words with a short, half-long or long consonant in the intervocalic position (C2). The vowel in the initial stressed syllable (V1) was a phonologically short or long monophthong or diphthong, while the second syllable vowel (V2) was always phonologically short. Additionally, the second syllable was open or closed by a short voiced consonant. Hence, the analysed foot structures were as follows: 1) CVCV – a short vowel or diphthong followed by a short consonant (Q1), e.g. *sare* ‘blueberry, acc/gen.sg’, *kye’le* ‘fish, acc/gen.sg’; 2) CVCCV – a short vowel followed by a half-long consonant (Q2) (in the orthography it is marked with a dot under a single letter), e.g. *saṛe* ‘blueberry, nom.sg’; 3) CVC:CV(C) – a short vowel or a diphthong followed by a long consonant (Q3), e.g. *pállu* ‘ball, nom.sg’, *uáb'bi* ‘sister, nom.sg’; 4) CVVCV(C) – a long vowel or a diphthong followed by a short consonant (Q1), e.g. *määli* ‘soup, acc/gen.sg’, *muorâ* ‘tree, acc/gen.sg’; 5) CVVCCV(C) – a long vowel or a diphthong followed by a half-long consonant (Q2), e.g. *määḷi* ‘soup, nom.sg’, *muoṛâ* ‘tree, nom.sg’. In total 729 words were used for this study (see Table 1).

Table 1. The number of analysed tokens.

Foot Structure	V1 Type	
	Monophthong	Diphthong
CVCV	24	8
CVCCV	81	–
CVC:CV(C)	192	52
CVVCV(C)	98	37
CVVCCV(C)	173	64

The durations of all segments of the test words were labelled and measured in Praat [2]. Statistical analysis was carried out using the LME4 package in R [1]. The log-scaled durations were tested with a mixed effects model. Since the system is not complete and is lacking two combinations (short diphthongs cannot occur before half-long consonants and long diphthongs or monophthongs cannot occur before long consonants), we considered the combination of V1 Quantity and C2 Quantity as one factor for the purpose of better comparison between foot structures. Therefore the durations were tested for two factors: 1) the initial syllable vowel type (V1 Type, levels: monophthong, diphthong) and 2) the five possible V1 and C2 length combinations (Foot Structure, levels: CVCV, CVCCV, CVC:CV, CVVCV, CVVCCV).

3. RESULTS

The durations of all segments in the analysed foot structures are shown in Figure 1 and the average durations with standard deviations are presented in Table 2, where C1 is a word-initial consonant, V1 is a short or a long monophthong or diphthong in the first syllable, C2 marks an intervocalic consonant and V2 is the nucleus of the second syllable. The effect of the word-final short consonant on the durations of preceding segments was tested, but no significant influence was found and thus the words with an open or closed second syllable are analysed together. Similarly, the phrasal position did not have a significant effect on the quantity system and therefore the words in phrase-medial and phrase-final position were pooled together.

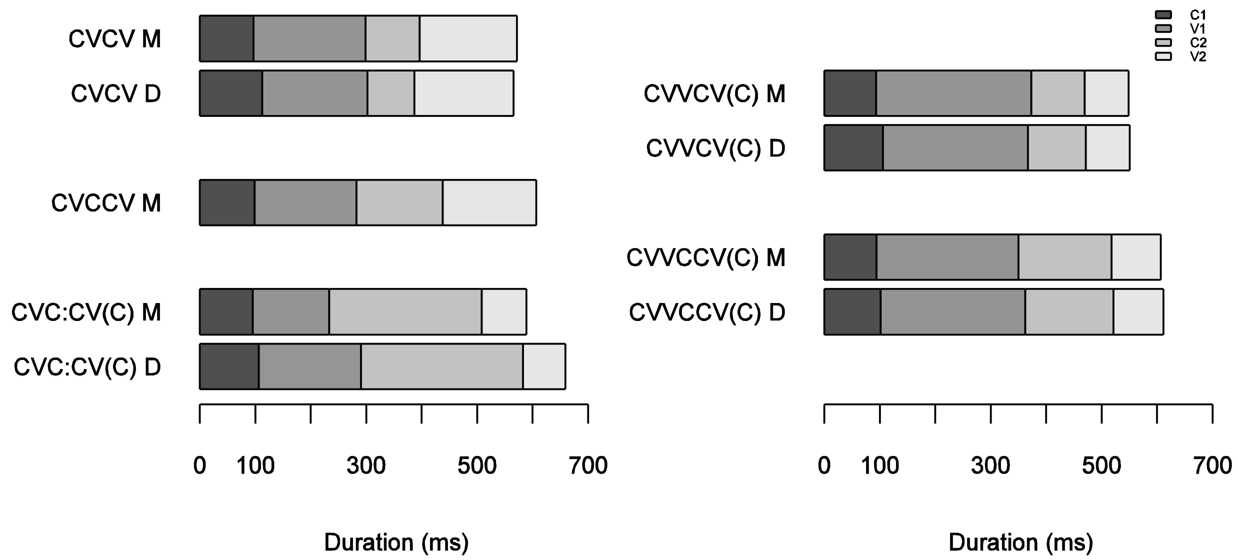
Table 2. Average segment durations and standard deviations (in milliseconds) in the analysed foot structures. M marks a monophthong and D a diphthong.

Foot Structure	V1 Type	C1	V1	C2	V2	Total
CVCV	M	97	202	97	176	572
	s.d.	15	44	23	38	84
	D	112	190	85	178	565
	s.d.	19	22	15	32	51
CVCCV	M	99	183	156	168	606
	s.d.	24	33	36	36	98
CVC:CV(C)	M	96	138	275	80	641
	s.d	25	24	78	20	111
	D	107	184	292	76	703
	s.d.	30	32	81	18	126
CVVCV(C)	M	93	280	96	79	550
	s.d.	21	57	19	19	83
	D	106	261	104	79	530
	s.d.	24	54	22	19	79
CVVCCV(C)	M	94	256	168	89	647
	s.d	24	49	46	31	123
	D	102	261	159	90	654
	s.d.	23	48	36	25	111

The duration of the word-initial consonant (C1) is 93–99 ms before monophthongs and 102–112 ms before diphthongs. The main effect of V1 Type is significant [$\chi^2(df=9, N=729)=11.49$, $p<0.001$], but there is no effect of Foot Structure.

The duration of the vowel in the first syllable is affected by Foot Structure which has a significant main effect [$\chi^2(df=10, N=729)=273.05$, $p<0.001$], and there is also a significant interaction between Foot Structure and V1 Type [$\chi^2(df=12, N=729)=34.04$, $p<0.001$]. Post-hoc testing shows that the duration of a short monophthong is significantly longer before Q1 and Q2 consonant (202 and 183 ms) vs. Q3 consonant (138 ms) ($p<0.001$), but the duration of a short diphthong preceding Q1 and Q3 consonant does not differ remarkably (the durations 190 ms and 184 ms respectively). There is no significant difference in the duration of a long monophthong preceding Q1

Figure 1. Average segment durations in the words with a phonologically short V1 (left panel) and long V1 (right panel). M stands for a monophthong and D for a diphthong in the first syllable.



and Q2 consonant (the durations 280 ms and 256 ms respectively) and the durations of long diphthongs before Q1 and Q2 consonants also remain the same (in both contexts 261 ms). Within the same foot structure short monophthongs (202 ms) and short diphthongs (190 ms) as well as long monophthongs (256–280 ms) and long diphthongs (261 ms) are of similar length, except for the Q3 consonant context where a short diphthong (184 ms) is longer than a short monophthong (138 ms) ($p<0.001$).

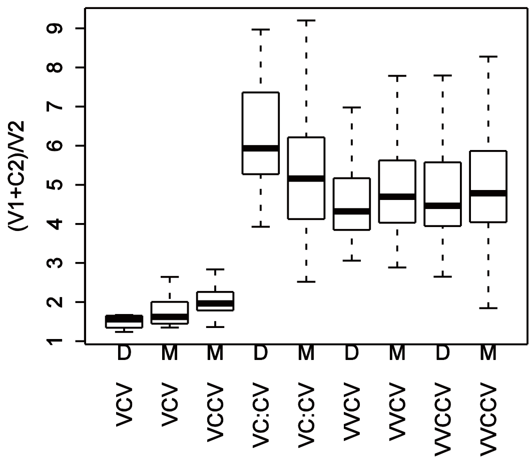
In the case of intervocalic consonant (C2) there is a significant main effect of Foot Structure [$\chi^2(df=9, N=729)=318.48$, $p<0.001$], but no interaction between Foot Structure and V1 Type. After a short vowel an intervocalic consonant has three degrees of length (short, half-long and long: 97 ms, 156 ms, and 275 ms) that are significantly different ($p<0.001$). After a short diphthong consonant has two degrees of length (short and long: 85 ms and 292 ms) and after a long vowel and a long diphthong it also has two degrees of length (short and half-long: 96 ms and 168 ms after monophthongs and 104 ms and 159 ms after diphthongs), being also significantly different ($p<0.001$). There is no significant difference in Q1 consonant duration depending on the V1 being short or long nor V1 being a monophthong or a diphthong. Similarly, Q2 consonant has the same length in the case of the preceding short or long monophthong and diphthong.

The main effect of Foot Structure on the second syllable vowel (V2) duration is significant [$\chi^2(df=9, N=729)=241.82$, $p<0.001$], but without any interactions. In the words where the syllable nucleus is short, the vowel in the second syllable has similar duration after Q1 and Q2 consonant (176–178 ms and 168 ms respectively), but it is shorter after Q3 consonant (76–80 ms). The difference is significant in the opposition of Q1 and Q2 vs. Q3 ($p<0.001$). In the case of a long V1 the duration of V2 also does not differ after Q1 and Q2 consonant (79 ms and 89–90 ms respectively). Thus, after a short monophthong or a diphthong followed by a Q1 or Q2 consonant the second syllable vowel is lengthened, while in words with a short V1 followed by Q3 consonant and in words with a long V1 (regardless of C2 length) it is shortened.

The Foot Structure has significant main effect on the whole foot duration [$\chi 2(df=8, N=729)=16.34$, $p<0.01$], and post-hoc test shows the difference between the structures VVCV and VC:CV ($p<0.05$); and between VVCCV and VVCV ($p<0.001$). On average, CVCV words are 565–572 ms, CVCCV words 606 ms and CVC:CV(C) words are 641–703 ms long. The average duration of the words with CVVCV(C) structure are 530–550 ms and CVVCCV(C) words are 647–654 ms long. Words with a short diphthong preceding Q3 consonant are the longest (703 ms) and structures with a long diphthong before a short consonant are the shortest (530 ms). The fact that words with different structure are roughly of the same length shows that the domain of the three-way quantity distinction is a disyllabic foot in Inari Saami.

In order to observe the differences in the compensatory mechanism of the segments within the foot we also calculated the duration ratios of segments (by summing the durations of the first syllable vowel with an intervocalic consonant, and dividing it by the duration of the vowel in the second syllable) that are presented in Figure 2.

Figure 2. Duration ratios of (V1+C2)/V2 in the analysed foot structures. Monophthongs are marked with M and diphthongs with D.



The V1C2/V2 ratio shows a significant effect of Foot Structure [$\chi 2(df=8, N=729)=151.26$, $p<0.001$] and a significant interaction of Foot Structure and V1 Type [$\chi 2(df=12, N=729)=8.03$, $p<0.05$]. However, from the Figure 2 we can see a robust two-way distinction of the words with a short V1 followed by Q1 or Q2 consonant on the one hand and both the words with a short V1 followed by Q3 consonant, and words with a long V1 on the other hand. In words with a short vowel followed by a short or a half-long consonant, the durations of the surrounding vowels are of similar length, but if C2 or V1 is long, the second syllable vowel is shortened to compensate the lengthening in the preceding segments. In words with a short V1 and a long C2, the first syllable vowel is shortened, but the effect is stronger with monophthongs than diphthongs.

4. DISCUSSION

Earlier studies on the three-way distinction of consonants in Inari Saami have shown that after a short first syllable vowel there is a clear ternary opposition in consonant length, and that the segmental durations in a disyllabic unit are inversely related [4, 14]. Bye et al [4] report that after a long first syllable vowel the distinction is varying between speakers and is not as evidential. Our results also show that in the case of short monophthongs, an intervocalic consonant has three-way distinction of length, but in the case of long monophthongs, the following consonant is short or half-long. Also, according to the present study the second syllable vowel is only lengthened when a monophthong or a diphthong in the first syllable is short and the preceding consonant is short or half-long. This refers to the compensatory relation between segments.

In earlier phonological research, the distinction of short and long diphthongs before consonants with various length was indicated [12]. Our data show that the contrast between short and long diphthongs appears only before short consonants; long consonants are preceded by short diphthongs, half-long consonants by long diphthongs.

5. CONCLUSIONS

In this paper we observed the ternary length distinction realised in different foot structures of Inari Saami. Disyllabic words with a short vowel in the first syllable show a ternary distinction in consonant duration, but after a short first syllable diphthong the distinction is binary (a short or long consonant). The distinction is also binary after a long first syllable vowel or diphthong (a short or a half-long consonant). There is a compensatory relation between segment durations. When a phonologically short syllable nucleus precedes an intervocalic short and half-long consonant, the surrounding vowels are both lengthened, while in long consonant context the vowels are shorter, except for a short diphthong which does not shorten to that extent as a short monophthong. In words with a long first syllable nucleus preceding both a short and a half-long consonant the vowel of the second syllable is also shortened, compensating for the length of a long first syllable vowel. These results show that in Inari Saami the ternary distinction of consonants is a foot-level phenomenon. It is in line with findings about other Finno-Ugric languages where three-way quantity contrasts occur.

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