The Durational Structure of Tetrasyllabic Words in Inari Saami

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Abstract

This study focuses on the temporal properties of Inari Saami tetrasyllabic words that consist of two metric feet of different quantity degrees. In this study, we analyze the durational structures of primary and secondary stressed feet. The material comes from four elderly native speakers of Inari Saami who read carrier sentences with tetrasyllabic test words. The durations of all segments in the test words were measured and the durations and duration ratios of the feet were analyzed. The temporal properties of tetrasyllabic words are compared to earlier findings on di- and trisyllabic words in Inari Saami and to Estonian and Livonian which both exhibit a three-way consonantal quantity distinction similar to Inari Saami. The results showed that tetrasyllabic words are mainly divided into two disyllabic feet where the first two syllables form a primary stressed foot and the secondary stress is on the third syllable. However, a pattern where a trisyllabic foot is followed by a stressed fourth syllable also occurs in our data. The phonological three-way distinction in consonants is exhibited in primary stressed feet; in secondary stressed feet the opposition is binary as consonants are either short or long.

Index Terms: Inari Saami, word prosody, stress, foot, quantity, geminates

1. Introduction

In Inari Saami, a simple word stem typically contains two syllables that may be followed by derivational and/or inflectionaliformative which may themselves be at least monosyllabic. Words are mostly divided into feet following a trochaic pattern with a stressed initial syllable and a following unstressed syllable. Trisyllabic words in Inari Saami form a trisyllabic foot with two unstressed syllables following the primary stressed initial syllable. This study is a preliminary investigation of the stress and temporal patterns in Inari Saami tetrasyllabic words with a focus on comparing the durational structure of their primary and secondary stressed feet.

The three-way quantity distinction of consonants in Inari Saami occurs in the primary stressed feet at the border of the first (S1) and second syllable (S2). Consonants can have three distinctive lengths: short (referred to as Q1), half-long (Q2) and long (Q3) [1–3]. Vowels and diphthongs in stressed syllables can either be short or long and in unstressed syllables vocalic length is not distinctive [4]. The three-way consonantal quantity distinction also occurs between S1 and S2 of trisyllabic words; at the border of the second and third syllable (S3), the opposition is binary (short vs. long) [5]. There are no acoustic-phonetic studies on longer words in Inari Saami. Hence, the aim of this paper is to fill this gap and analyze tetrasyllabic words.

Morphologically, the tetrasyllabic words analyzed in this study can be divided into two declension classes: tetrasyllabic nominals and nominals with contracted stems. For the former, four syllables can still be attested in some cases, such as the nominative plural (e.g., cähálig ‘fairies’) or the locative singular (cäháliggest) or illative singular (cäháligän), but the original number of syllables has not been preserved in the nominative singular, which is trisyllabic and consonant-final (cähälig ‘fairy’). Nominals with contracted stems, on the other hand, are nominals in which the original stem-final consonant has been lost. In our data, these are deverbal agent nouns which end in -eijee and are tetrasyllabic in most cases, including the nominative singular (e.g., kuđâsteijee ‘fisherman’) [6].

In this study, the following research questions are asked:

1) What are the main foot structures of Inari Saami tetrasyllabic words?
2) How are quantity distinctions manifested in primary stressed feet of tetrasyllabic words?
3) How are quantity distinctions manifested in secondary stressed feet of tetrasyllabic words?
4) Which durational properties are characteristic of the overall structure of tetrasyllabic words?
5) Whether the temporal structure of Inari Saami tetrasyllabic words is similar to or different from Estonian and Livonian, and if so, how?

2. Material and method

The data used in this study was collected in 2013 from four native speakers of Inari Saami (aged 62, 68, 76 and 77 years at the time of the data collection). The speakers were all male and two of them came from northern and two from western areas of Inari Saami territory. These speakers were chosen for the recording because Inari Saami is their first language and they have spoken it regularly their whole lives. All of the speakers reported that they speak Finnish and three of them had good knowledge of North Saami.

The recordings were done in a quiet room with an Edirol R-09 digital recorder at a sampling rate of 48 kHz and with 16 bits per sample. The speakers were asked to read carrier sentences which contained test words (at phrase-final and sentence-final positions). Examples of the carrier sentences are as follows (test words are marked in bold):

(a) Sust lâd love purramâšsad, mut sist lâd love pajalâšsad.
‘He/she has ten dishes, but you have ten desserts.’

(b) Taa lii ohtâ kuđâsteijee, mut tobben lii ohtâ mätâsteijee.
‘Here is one fisherman, but there is one teacher.’

The test words had seven different segmental structures (presented in Table 1) that were divided into two stress patterns: 1) disyllabic primary stressed foot followed by a disyllabic secondary stressed foot (structures 1–4 in Table 1 below); 2) trisyllabic primary stressed foot followed by a secondary stressed fourth syllable (structures 5–7 in Table 1). The total number of words analyzed was 66.
Table 1: Number of tokens and examples for the seven tetrasyllabic word structures analyzed.

<table>
<thead>
<tr>
<th>No.</th>
<th>Word structure</th>
<th>Tok.</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CVCVCVCVC</td>
<td>16</td>
<td>cähálág’á ‘fairy, ILL.SG’</td>
</tr>
<tr>
<td>2</td>
<td>CVCVCVCVCVC</td>
<td>12</td>
<td>cähálágged ‘fairy, PART.SG’</td>
</tr>
<tr>
<td>3</td>
<td>CVCVCVCVCVCVC(C)(C)</td>
<td>17</td>
<td>mítííttejied, ‘teacher, PART.SG’</td>
</tr>
<tr>
<td>4</td>
<td>CVCVCVCVCVC</td>
<td>6</td>
<td>puurámáášáad, ‘food, PART.SG’</td>
</tr>
<tr>
<td>5</td>
<td>CVCVCVCVCVCC</td>
<td>8</td>
<td>cähálíggést, ‘fairy, LOC.SG’</td>
</tr>
<tr>
<td>6</td>
<td>CVCVCVCVCVV</td>
<td>4</td>
<td>kudítáástejée, ‘fisherman NOM.SG’</td>
</tr>
<tr>
<td>7</td>
<td>CVCVCVCVCVV</td>
<td>3</td>
<td>toíímtáátejée ‘editor, NOM.SG’</td>
</tr>
</tbody>
</table>

The structures for words with two disyllabic feet are as follows:
1) CVCVCVCVCV – all segments are short;
2) CVCVCVCVCVC – a short consonant between S1 and S2, a geminate between S3 and S4;
3) CVCVCVCVCVCC(C)(C) – a voiceless geminate between S1 and S2, a voiced geminate between S3 and S4;
4) CVCVCVCVCVCVC – a voiced geminate between S1 and S2, a voiceless geminate between S3 and S4.

The structures for words with trisyllabic primary stressed feet followed by a stressed fourth syllable are as follows:
5) CVCVCVCVCVCC – a short consonant occurs between S1 and S2 and between S2 and S3, a geminate between S3 and S4 followed by a long vowel;
6) CVCVCVCVCVCC – a short consonant between S1 and S2, a consonant cluster between S2 and S3, a geminate between S3 and S4 followed by a long vowel;
7) CVCVCVCVCVCCVCC – a consonant cluster between S1 and S2, a geminate between S3 and S4 followed by a long vowel.

For analyzing the durational structure of the Inari Saami tetrasyllabic words, all the test words were annotated and the durations for each segment in a word were measured in milliseconds using Praat [7]. Statistical analyses were done with R [8] using the LME4 package [9]. The log-scaled durations of intervocalic consonants (C2 and C4) and the surrounding vowels (V1, V2, V3, V4) were tested with mixed effects models for five factors and their interactions: phrasal position (phrase-medial, phrase-final), C2 length (short, long), C4 length (short, long), C2 voicing (voiced, voiceless), V4 length (short, long). In the models, a speaker and a test word were considered as random factors. The models were built in an incremental way by adding fixed effects and their interactions and testing their significance.

3. Results

The results for segmental durations in Inari Saami tetrasyllabic words are summarized in Table 2 and Table 3, the former showing the results for the words with disyllabic secondary stressed feet (structures 1–4 in Table 1) and the latter for the words with monosyllabic secondary stressed feet (structures 5–7). Figure 1 and Figure 2 illustrate the results, respectively. In
Table 2: Average segment durations and standard deviations (in brackets) in milliseconds for C1, V1, C2, V2, C3, V3, C4, V4, C5 in the word structures with trochaic stress patterns. Foot 1 is the sum of V1, C2, and V2 forming a primary stressed foot and Foot 2 is the sum of V3, C4, and V4 forming a secondary stressed foot.

<table>
<thead>
<tr>
<th>No.</th>
<th>Structure</th>
<th>C2 voicing</th>
<th>C4 voicing</th>
<th>C1</th>
<th>V1</th>
<th>C2</th>
<th>V2</th>
<th>C3</th>
<th>V3</th>
<th>C4</th>
<th>V4</th>
<th>C5</th>
<th>Foot 1</th>
<th>Foot 2</th>
<th>Foot 1/ Foot 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CVCVCVCVC</td>
<td>voiced/ voiceless</td>
<td>voiceless</td>
<td>98</td>
<td>(30)</td>
<td>118</td>
<td>(20)</td>
<td>96</td>
<td>(31)</td>
<td>87</td>
<td>(11)</td>
<td>95</td>
<td>(21)</td>
<td>103</td>
<td>(20)</td>
</tr>
<tr>
<td>2</td>
<td>CVCVCVCVCVC</td>
<td>voiced/ voiceless</td>
<td>voiceless</td>
<td>118</td>
<td>(15)</td>
<td>119</td>
<td>(25)</td>
<td>103</td>
<td>(26)</td>
<td>91</td>
<td>(16)</td>
<td>86</td>
<td>(20)</td>
<td>230</td>
<td>(51)</td>
</tr>
<tr>
<td>3</td>
<td>CVCCVCVCVCVC(C)(C)</td>
<td>voiceless voiced</td>
<td>72</td>
<td>(9)</td>
<td>104</td>
<td>(16)</td>
<td>241</td>
<td>(25)</td>
<td>90</td>
<td>(9)</td>
<td>186</td>
<td>(22)</td>
<td>57</td>
<td>(12)</td>
<td>207</td>
</tr>
<tr>
<td>4</td>
<td>CVCCVCVCVCVC</td>
<td>voiced</td>
<td>voiceless</td>
<td>118</td>
<td>(17)</td>
<td>104</td>
<td>(104)</td>
<td>140</td>
<td>(21)</td>
<td>96</td>
<td>(12)</td>
<td>93</td>
<td>(9)</td>
<td>198</td>
<td>(29)</td>
</tr>
</tbody>
</table>

Table 3: Average segment durations and standard deviations (in brackets) in milliseconds for C1, V1, C2, V2, C3, V3, C4, V4, C5 in the word structures with trisyllabic primary stressed feet and secondary stressed fourth syllable.

<table>
<thead>
<tr>
<th>No.</th>
<th>Structure</th>
<th>C2 voicing</th>
<th>C4 voicing</th>
<th>C1</th>
<th>V1</th>
<th>C2</th>
<th>V2</th>
<th>C3</th>
<th>V3</th>
<th>C4</th>
<th>V4</th>
<th>C5</th>
<th>Foot 1</th>
<th>Foot 2</th>
<th>Foot 1/ Foot 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>CVCVCVCVCVCVCVCVC</td>
<td>voiceless</td>
<td>voiceless</td>
<td>101</td>
<td>(26)</td>
<td>105</td>
<td>(25)</td>
<td>112</td>
<td>(41)</td>
<td>91</td>
<td>(21)</td>
<td>73</td>
<td>(12)</td>
<td>78</td>
<td>(25)</td>
</tr>
<tr>
<td>6</td>
<td>CVCVCVCVCVCVCVC</td>
<td>voiced</td>
<td>voiced</td>
<td>100</td>
<td>(15)</td>
<td>102</td>
<td>(12)</td>
<td>64</td>
<td>(24)</td>
<td>131</td>
<td>(16)</td>
<td>194</td>
<td>(31)</td>
<td>75</td>
<td>(20)</td>
</tr>
<tr>
<td>7</td>
<td>CVCCVCVCVCVCVCVC</td>
<td>voiceless voiced cluster</td>
<td>93</td>
<td>(20)</td>
<td>112</td>
<td>(9)</td>
<td>156</td>
<td>(33)</td>
<td>60</td>
<td>(23)</td>
<td>217</td>
<td>(16)</td>
<td>59</td>
<td>(11)</td>
<td>242</td>
</tr>
</tbody>
</table>

Figure 1: Mean durations of C1, V1, C2, V2, C3, V3, C4, and V4 in the words with dissylabic secondary stressed feet

3.2. Monosyllabic secondary stressed feet

The average durations for the segments in words with monosyllabic secondary stressed feet are shown in Table 3 and Figure 2. In these word structures, only a long geminate occurs in C4 position and the following vowel (V4) is long.

Overall, in the words with monosyllabic secondary stressed feet the average durations of geminates in C4 positions are longer (242–278 ms) than the corresponding geminates in dissylabic secondary stressed feet (198–230 ms) that have short vowels following C4.
4. Discussion

In this study, the stress patterns and temporal structures of Inari Saami tetrasyllabic words were investigated. The results showed that tetrasyllabic words exhibit two different stress patterns: 1) a disyllabic primary stressed foot followed by a secondary stressed disyllabic foot, 2) a trisyllabic primary stressed foot followed by a secondary stressed monosyllabic foot.

Comparing the results for tetrasyllabic words to earlier findings about Inari Saami di- and trisyllabic words shows that tetrasyllabic words have a specific durational structure that differs from the shorter words. The phonological three-way distinction in consonants is possible only in primary stressed feet; in secondary stressed feet the opposition is binary as consonants are either short or long. The duration ratios of short consonants to long geminates are similar in the primary stressed and secondary stressed feet in the case of voiceless C2 geminates. Long geminates are two times longer than short consonants. The earlier findings on Inari Saami disyllabic words have shown that long geminates are 2.8 times longer than short consonants [5] and in trisyllabic words the ratio of short consonants to long geminates at the boundary of S1 and S2 is 2.3 [6]. Thus, the ratio of short consonants to geminates in tetrasyllabic words is closer to that in trisyllabic words.

Whereas in the words with two disyllabic feet the durations of the primary and secondary stressed feet were roughly of similar length, the relations between the segments within the feet differed. While the primary stressed vowel was longer before a short consonant than before a long geminate, the unstressed vowel retained its duration regardless of the length of the previous consonant. In the secondary stressed feet, both surrounding vowels preserved their durations when neighboring short consonants as well as geminates. In earlier studies on Inari Saami disyllabic words it has been shown that the durations of both vowels are affected by the length of the intervocalic consonant, being shorter when neighboring longer consonants [1], [2]. The vocalic durations in trisyllabic words have shown a different pattern – the unstressed vowel in the second syllable is inversely related to the length of the preceding consonant, while the stressed vowel is not [5]. As was seen in the current study, the situation is reversed in the case of Inari Saami tetrasyllabic words and is similar to the durational patterns of disyllabic words in North Saami where only the duration of the stressed vowel is inversely affected by the length of the following consonant [10], [11].

It has been discussed in earlier studies on Estonian that tetrasyllabic words are divided into two disyllabic units where each of these units is comparable with disyllabic words [12]. It has been shown that the lengthening of an unstressed vowel after a short consonant in disyllabic words [13], [14] is also evident in tri- and tetrasyllabic words [12]. Later it was found that multi-foot words in Estonian have specific durational patterns that depend on the general structure of the prosodic word [15]. Studies on penta- and hexasyllabic words have shown that the unstressed vowels after short consonants do not lengthen in the same way that they do in di- and tetrasyllabic words [16] and the lengthening of an unstressed vowel occurs in primary stressed feet, but not in secondary stressed feet [17]. For Livonian tetrasyllabic words it has been found that the syllable durations and duration ratios of secondary stressed feet are similar to those of primary stressed feet, however, the unstressed syllables are lengthened more in the case of primary stressed feet [18]. Comparing Inari Saami tetrasyllabic words to longer words in Estonian and Livonian, there is no such lengthening of the unstressed vowel. It is the primary stressed vowel that shares its duration with the following consonant. The durations of unstressed vowels are almost always shorter than the stressed ones in primary as well as secondary stressed feet.

5. Conclusions

This study analyzed the durational structure of Inari Saami tetrasyllabic words with two types of stress patterns. The focus was on comparing primary and secondary stressed feet and on the manifestation of quantity oppositions in the latter. The results showed that tetrasyllabic words in Inari Saami are mainly divided into two disyllabic trochaic feet with secondary stress on the third syllable. In the secondary stressed trochaic feet vowels are phonologically short but between the vowels of such feet short or long consonants can occur. Secondly a pattern with a trisyllabic primary stressed foot is also present in our data. In this type of tetrasyllabic words, a stressed fourth syllable contains a phonologically long vowel. The relations between segments differ from di- and trisyllabic words as only the primary stressed vowel is affected by the length of the following consonants in tetrasyllabic words.

6. Acknowledgements

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7. References