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THE TEMPORAL STRUCTURE OF LIVONIAN TRI-, TETRA- AND PENTASYLLABIC WORDS

Abstract. The article focuses on Livonian trisyllabic, tetrasyllabic and pentasyllabic words, comparing the temporal structures of non-initial syllables and secondary-stressed feet. Durations and duration ratios of the syllables in words with different structure were analyzed on the basis of phonetic data from three generations of Livonian speakers. The results from trisyllabic words show that the lengthening of unstressed syllables is not a regular pattern and is valid only in certain word structures. In trisyllabic words with a long initial syllable followed by a short vowel in the second and third syllable, the duration of the vowel in the second syllable is always shorter than that of the third syllable vowel. In the case of tetrasyllabic words, the syllable durations and duration ratios of the secondary-stressed feet are similar to those of the primary-stressed feet, but unstressed syllables are lengthened significantly more in a primary-stressed foot than in a secondary-stressed foot. The duration of trisyllabic secondary-stressed feet in pentasyllabic words is similar to that of primary-stressed feet when the word contains the derivational affix *-nikā*.

Keywords: Livonian, quantity, stress, foot, prosody.

1. Introduction

A simplex word usually contains one to five syllables in Livonian, cf. *sī* 'guilt', *pāvaļikīzō* 'sun, IllSg'.¹ The word stem may be followed by an inflectional formative that may consist of a number of syllables. With the exception of a few monosyllabic words that may be unstressed in the sentence, a word has at least one stressed syllable. The primary stress in Livonian is on the first syllable of a word. This is valid also for foreign words. Only short-syllable verb prefixes borrowed from Latvian can be unstressed, e.g. *noļvō-ttō* 'remove, Inf'. Long-syllable prefixes have a similar stress to that of the stem, e.g. *a-tla-ndō* 'give back, Inf'.

Feet in Livonian consist of one to three syllables, with disyllabic feet being the most typical. Like in Estonian, a trisyllabic simple word can form a foot in Livonian, where the stressed syllable is followed by two unstressed syllables (*ka-lādōn* 'fish, DPI'). If a prosodic word has four or more syllables, the secondary stress is usually on the third syllable of a word

¹ The length of a vowel is orthographically marked with a macron in Livonian.

(*pie·dāgõ:dõn* 'pine, DPI'). If a word has five syllables or a larger odd number of syllables, the secondary-stressed foot is usually trisyllabic (*o·pāti:jizõn* 'teacher, DSg'). However, in the derivational affix *-nikā* the secondary stress can be on the second syllable of a word in all cases, e.g. *bū·oḥni:kā* 'shopkeeper', *mō·ni:kkõ* 'peasant, PSg', *mō·izni:kēdi* 'squire, PPI'. Also, non-initial syllables with a long vowel in late loanwords can have a secondary stress, e.g. *ka·ptē:n* 'captain', *be·nzī:n* 'petrol'. In compounds, each component preserves its stress pattern.

Although the relation between word quantity and secondary stress has not been discussed very extensively in the previous prosodic descriptions of Livonian, the main aspects are presented in Viitso 1981; 2007; 2008, and Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008. Acoustic-phonetic studies have shown that like in Estonian, there is a tendency to balance syllable durations to achieve foot isochrony in Livonian (Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008; Tuisk, Teras 2009; Tuisk 2012). However, in Livonian, the syllable durations in secondary-stressed feet appear to be shorter than in primary-stressed feet (Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 : 64–67). Namely, secondary-stressed feet in tetrasyllabic words with a short open first syllable and a half-long second syllable vowel (e.g. *salāndõbõd* 'they steal', *pūṛin-tõbõd* 'they sail') have a shorter duration than primary-stressed feet with the same structure ($V_4 = 85$ ms and $V_3 = 70$ ms, in primary-stressed feet $V_1 = 103$ ms and $V_2 = 211$ ms²). The duration ratio of the vowels is greater in secondary stressed feet (0.8) and smaller in primary-stressed feet (0.5).

Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso (2008) have shown that secondary-stressed feet containing a geminate consonant also have shorter durations than primary-stressed feet of the same structure. In the secondary-stressed foot of tetrasyllabic words where there is a short geminate and a half-long second syllable vowel, the duration ratio of syllables is 0.8 (e.g. *pāvaļikīz(t)* 'sun, GSg (PSg)', *pūṛõnikā* 'sailboat'). The ratio is the same in primary-stressed feet with the same structure. Vowel and geminate durations are similar in the feet occurring in both positions. In the secondary-stressed feet with a long geminate and a short second syllable vowel (e.g. *pāvaļikki* 'sun', *pūṛõnikkõ* 'sailboat, PSg'), the duration ratio of the syllables varies from 1.9 to 5.2, depending on the speaker (2.6 on average). The ratios vary because of the shortening of the duration of the second syllable vowel.

2. Research background and aims

The main aim of the current study is to describe and analyze non-initial syllables and secondary-stressed feet in Livonian polysyllabic words with various structures. The analysis focuses on the comparison of the syllable rhyme durations and duration ratios in trisyllabic, tetrasyllabic and pentasyllabic words. In the comparison of the primary-stressed feet and secondary-stressed feet, previous acoustic-phonetic studies on Livonian will be considered. The material will also be compared to similar studies on Estonian, as the temporal structure of Estonian and Livonian is comparable in many ways.

² V in the current paper stands for a vowel.

The relation between word quantity and secondary stress in Estonian has been discussed thoroughly in earlier prosodic descriptions (e.g. Lehiste 1965). One of the research problems concerns the question of how the quantity of the primary-stressed foot influences the position of the secondary stress. Another question is whether the quantity oppositions are similar in primary-stressed and secondary-stressed feet. Attention has been given to the impact of the durational relations of the non-initial syllables on the structure of the primary-stressed foot, and, thus, the complex nature of the word as a prosodic whole (see for example Ariste 1963). However, the quantity degrees in secondary-stressed feet were not determined outside gradational affixes. Secondary-stressed feet were claimed to have a more simple structure than primary-stressed feet. This tradition was first broken by Ilse Lehiste (1965), who proposed that stresses and quantities are independent of each other in Estonian and that one can distinguish between all three quantity degrees in a syllable following a Q3 syllable.³ According to her study, an Estonian tetrasyllabic word is divided into two disyllabic units that are similar to a disyllabic word (Lehiste 1968 : 301). Thus, one can conclude that in Estonian, the structures of primary-stressed and secondary-stressed feet are in principle similar.

A study on the temporal structure of Estonian secondary-stressed feet by Pajusalu, Help, Lippus, Niit, Teras, Viitso (2005) has shown that multi-foot words in Estonian cannot be interpreted as identically structured sequences of feet and that the words are characterized by specific durational patterns. A comparison of the western and eastern peripheries of Estonia revealed that in Saaremaa (western periphery) the unstressed vowel in a secondary-stressed foot has generally lengthened, and the duration ratios in the secondary-stressed foot are similar to those of the primary-stressed foot. The analysis (Pajusalu, Help, Lippus, Niit, Teras, Viitso 2005) showed that the lengthening of the vowel in an unstressed syllable is not a permanent feature, being absent from the secondary-stressed feet in Q1 words in the southern Estonian pronunciation of Võrumaa (eastern periphery). Exceptionally, an extensive lengthening was observed in the first secondary-stressed foot in hexasyllabic words in both regions. The study also pointed to the fact that regardless of the position of the secondary stress, in both peripheries of Estonia, five-syllable and six-syllable words are characterized by a similar basic pattern of the temporal structure of the word. The third syllable tended to be the shortest and the following fourth syllable much longer independent of stress. A similar pattern between northern and central Estonian pronunciation on the one hand and the southern Estonian pronunciation on the other was observed by Arvi Sepp (1980).

Investigation of the structure of Estonian trisyllabic words revealed that three contrastive consonant quantities occurring in disyllabic words do not occur between the second and third syllable in trisyllabic words (Lehiste 1997). Only two contrasts in this position occur: short and long. Short consonants in this position have the same duration as do short consonants between the first and second syllable. Long consonants between the second and third syllable are called ambiguously long as they cannot be immediately identified with either a contrastively long or overlong consonant. Note that the test words used for the study did not contain derivative suffixes.

³ Q1, Q2 and Q3 stand for the short, long and overlong quantity in Estonian.

Considering previous studies on Livonian and Estonian, it is hypothesized here that the structures of the primary-stressed feet and secondary-stressed feet are similar in Livonian, but there is a more noticeable tendency towards the shortening of secondary-stressed feet than in Estonian. An acoustic-phonetic study on Livonian (Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008) has already shown a similar tendency in tetrasyllabic words. The same pattern is expected to appear in Livonian trisyllabic secondary-stressed feet in pentasyllabic words. It is also assumed that the lengthening of unstressed syllables is not a regular pattern in Livonian, and is valid only in certain word structures. In the current paper, durations of short and long voiceless geminates in trisyllabic as well as tetra- and pentasyllabic words are analyzed. It is assumed that, like in the primary-stressed feet, there are two contrastive consonant quantity patterns in non-initial syllables, but geminate durations are shorter in non-initial syllables. Derivational affixes will be treated separately; in addition to the affix *-nikā* (*-nikkō*), the affix *-likīz/-ļikīz* (*-likki/-ļikki*) is analyzed.

Livonian differentiates two tones in stressed stem-initial syllables — the plain tone and the broken tone or *stød*. Studies on Livonian tones have shown that the duration of the stressed syllables in words with *stød* is usually smaller than the syllable duration in words with the plain tone (e.g. Teras, Tuisk 2009). In the current study this pattern is not analyzed, but the question of a similar tendency in words longer than two syllables is definitely intriguing. This would require a larger amount of data, including words with and without *stød* with the same structure. Thus only some observations about the pronunciation of words with *stød* will be made.

3. Material and method

The acoustic data for the current study come from the University of Tartu Archives of Estonian Dialects and Kindred Languages. The methodology and structure of the investigation is similar to that used for the previous analyses of Livonian prosody (Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008; Tuisk, Teras 2009; Tuisk 2012).

The analyzed words are from eight Livonian speakers who were recorded in the years 1976, 1997, 2000–2010. Of these eight, four were older speakers, born between 1889 and 1921. They spoke Livonian as their mother tongue. Two were middle-aged speakers, born in 1950 and 1957. They had heard Livonian from their parents and grandparents, but began to speak the language only as adults. The two younger speakers were born in the 1970s. One of them acquired Livonian as a teenager and another during childhood. The older and middle-aged speakers were born in the villages that belong to the eastern, central and western part of the Livonian Coast. The younger speakers were born in Riga.

The test words were grouped according to the number and structure of syllables as well as the position in the sentence or phrase. Most of the material consisted of words from the test sentences where the test words appear in phrase-final and sentence-final position. Due to the different reading list of the test-sentences there are some words that were read only by one speaker. These single words are not included in averaging (e.g. in Table 9). Also, words from word triplets were analyzed. Namely, two older

speakers repeated the test word three times. The last word of a triplet is selected for the study and analyzed together with the words in sentence-final position. On one occasion the first and the second word of a triplet is analyzed as well, the particular reason for that is provided in subchapter 4.3. In addition, one word structure in phrase-medial position from spontaneous speech from one speaker will be examined. Examples of the word structures with three syllables are *ka·zābōd* 'they grow', *ti·kādōn* 'goats, DPI', *ka·'ddōbōd*⁴ 'they disappear', with four syllables *pu·ŗŗōni:kā* 'sailboat' and *pu·ŗŗōni:kkō* 'sailboat, PSg', with five syllables *pā·vaļi:kīzō* 'sun, IllSg', *va·ļāni:kādōn* 'cottagers, DPI'. Note that there is a difference between half-long vowels and short vowels in an unstressed position. Half-long vowels⁵ are longer than the stressed short vowels. Almost all consonants in Livonian can be geminates, and are thus divided between two syllables.⁶ Both the short geminate and long geminate close the preceding syllable.

A total of 297 words were analyzed. The test words and phoneme boundaries were manually tagged using the speech analysis software Praat (Boersma, Weenink 2014–2015), after which segment durations were extracted from the annotated TextGrid using a script. The method used to calculate the durations of the syllables and syllable ratios is the same used in previous studies (e.g. Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008). Syllable duration equals the duration of the syllable rhyme, which consists of the obligatory nucleus followed by an optional coda. The duration of a closed syllable rhyme was calculated by measuring the duration of the vowel and the part of the geminate consonant or consonant cluster preceding the syllable boundary. The syllable boundary in the geminate was calculated by measuring the duration of the geminate and subtracting the part that constitutes the initial consonant of the following syllable (Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 : 42). This was established by measuring the duration of single word-initial and syllable-initial consonants. A word-initial consonant is longer than a syllable-initial consonant (e.g. Lehiste 1966); the duration of a syllable-initial consonant is approximately 70% of a word-initial consonant (the duration of a voiceless plosive is established in a voiced environment). Duration ratios presented in Tables are the averages of the duration ratios (i.e. not the ratios of average durations).

4. Results and discussion

4.1. Trisyllabic words

In trisyllabic words, the primary stress falls on the first syllable of a word. As already mentioned, there are exceptional words with the affix *-nikā* where the secondary stress falls on the second syllable, e.g. *mó·izni:kā* 'squire', *mó·izni:kkō* 'squire, PSg'. These words will be treated separately. Altogether twelve word structures occurring in trisyllabic words are discussed.

⁴ The apostrophe indicates to the words with *stød* or broken tone.

⁵ Half-long vowels in non-initial syllables are usually marked with a macron above the vowel letter.

⁶ Note that there are no geminates in word structures like *kazābōd* 'they grow', *jelābōd* 'they live' etc.

First, words with a short first syllable followed by a half-long second syllable and a short third syllable (words like *kazābōd*, N = 21) from spontaneous speech from one female speaker are briefly discussed. The vowel durations in the syllables are V1 = 70 ms, V2 = 137 ms, V3 = 64 ms, yielding V1/V2 = 0.52. The data from the same speaker obtained from the study on disyllabic words from spontaneous speech with the same syllable structure had the durations of V1 = 81 ms and V2 = 145, yielding V1/V2 = 0.56 (Tuisk 2012 : 6). The results of the disyllabic words from read speech reveal the same tendency (V1/V2 = 0.5; Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 : 118). Thus it can be concluded that although the S1 and S2 rhyme durations in trisyllabic words are decreased, the syllable ratios remain stable.

Segment durations of the words *tikādōn* 'goats, DPI' (*kikīdi* 'roosters, PPI' also belongs to this word type) and *vikātōks* 'with an axe' are presented in Table 1. These words have a short geminate after the first syllable vowel, a half-long second syllable vowel and a short third syllable vowel. The word *vikātōks* also has a short geminate after the second syllable vowel.

Table 1

Segment durations and syllable rhyme ratios in words
with a half-long second syllable vowel and a short third syllable vowel

Word	Position	N	V1	C	V2	C(C)	V3	S1/S2	S2/S3
<i>tikādōn</i>	PF	12	73	123	211	97	82	0.56	2.86
	SF	11	72	129	201	110	64	0.62	3.39
	Mean	23	73	126	206	103	73	0.59	3.13
<i>vikātōks</i>	PF	6	84	132	192	148	72	0.52	1.46
	SF	7	86	122	193	153	69	0.48	1.41
	Mean	13	85	127	192	151	71	0.50	1.43

The mean duration of the short geminate between V1 and V2 in the words *tikādōn* and *vikātōks* is nearly the same (126 and 127 ms), being similar to the short geminate duration in disyllabic words with the same structure (in disyllabic words like *tapāb* 'he/she kills' the short geminate duration was 131 ms; Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 : 134). The V2 duration is also similar to that in disyllabic words with the same structure (V2 = 207 ms). In the word *vikātōks* the V2 duration is somewhat shorter, which may be due to the part of the short geminate following the vowel. The mean V3 durations in the word types represented by *tikādōn* and *vikātōks* are 73 ms and 71 ms respectively. Thus, it seems that when the syllable ends with a voiceless consonant cluster, the vowel duration does not shorten significantly. The duration ratios of S1 and S2 rhymes are a little smaller in the trisyllabic words *tikādōn* and *vikātōks* (S1/S2 = 0.59 and 0.50) than in disyllabic words such as *tapāb* 'he/she kills' (S1/S2 = 0.8) from Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 : 134. This can be explained by the shorter S1 rhyme duration in trisyllabic words.

The derivational affix *-nikā* in the word *móiznikā* behaves somewhat differently (Table 2). The duration of the half-long S3 vowel in the affix is

considerably shorter than the half-long S2 vowel in the words *tikādõn* and *vikātõks*. The mean duration of the half-long vowel in *tikādõn* and *vikātõks* is 206 and 192 ms respectively, but in the word *mõiznikā*, the durations are 130 ms (in phrase-final position) and 147 ms (in sentence-final position).

Table 2

Segment durations and syllable rhyme ratios in the word *mõiznikā* 'squire'
 (PF = phrase-final, SF = sentence-final, N = number of words,
 * = duration of the diphthong)

Word	Position	N	V1	C	C	V2	C	V3	S2/S3
<i>mõiznikā</i>	PF	1	208*	74	70	81	112	130	0.87
	SF	1	264*	101	66	78	117	147	0.78

The short geminate duration in the word *mõiznikā* is 112 ms in phrase-final position and 117 ms in sentence-final position, which is shorter than the short geminate duration in the words *tikādõn* and *vikātõks* (126 and 127 ms).

Figure 1 illustrates the syllable rhyme durations of all three word types.

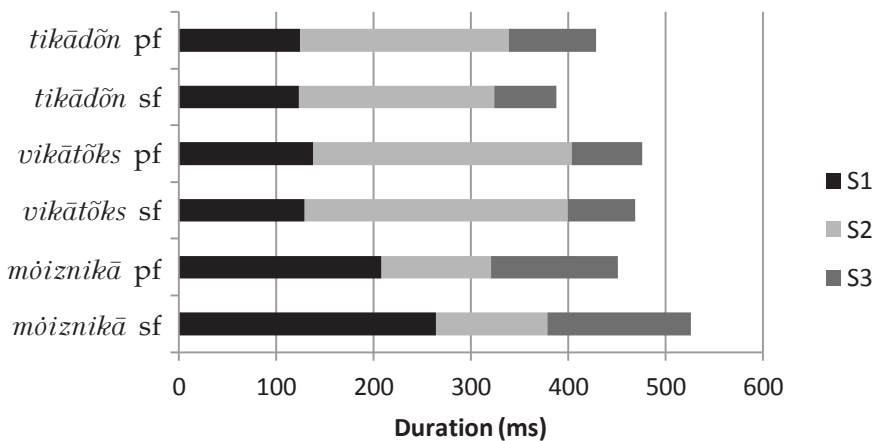


Figure 1. Syllable rhyme durations (ms) in words with a long first syllable and a half-long or long second syllable (pf = phrase-final position, sf = sentence-final position).

There is no significant lengthening of the syllable durations in sentence-final words. The exceptions are the words with the affix *-nikā*, where S1 and S3 rhymes in the word *mõiznikā* are lengthened in the sentence-final position but the S2 rhyme duration does not change. The difference may be explained by the fact that in the word *mõiznikā* the affix constitutes a secondary-stressed foot.

Next, words with a long first syllable followed by two unstressed syllable vowels are analyzed. Table 3 represents average segment durations of the words *võrõdõn* 'strangers, DPI' (the test word *õlidi* 'lips, PPI' belongs to this type as well), *mõtõbõd* 'they think' and *võ'dlõgõd* 'wait, JusPI'. These words have a short vowel in the second and third syllable.

Table 3

Segment durations and syllable rhyme ratios in words
with a long first stressed syllable and a short second and third syllable vowel
(PF = phrase-final, SF = sentence-final, N = number of words)

Word	Position	N	V1	C	C	V2	C	V3	S1/S2	S2/S3
<i>võrõdõn</i>	PF	9	257	51		82	97	99	3.27	0.86
	SF	7	249	61		77	101	96	3.24	0.86
	Mean	16	254	55		80	99	98	3.25	0.86
<i>mõtlõbõd</i>	PF	7	83	188	48	71	97	81	3.89	0.93
	SF	7	72	195	55	56	94	78	4.77	0.73
	Mean	14	77	191	51	64	96	79	4.33	0.83
<i>võ'dlõgõd</i>	PF	8	122	106	85	74	91	91	3.29	0.84
	SF	8	105	138	84	73	101	81	3.33	0.93
	Mean	16	114	122	84	73	96	86	3.31	0.89

There is one characteristic pattern that becomes evident in these three word types. Namely, the duration of V2 is always less than that of V3 (by one-way ANOVA the difference between V2 and V3 is significant [$F(1,90) = 10.72, p < 0.05$]). The mean S2 vowel duration (V2) is between 64 and 80 ms and the mean S3 vowel duration (V3) is between 79 and 98 ms.

Table 4 represents the average segment durations of the words with a long first syllable containing a geminate. There is a long voiced geminate in the words *li'ggõgõd* 'soak, JusPl' (test words such as *pu'ddõbõd* 'they fall', *ka'ddõbõd* 'they disappear' and *li'ggõbõd* 'they soak' are in this type as well) and a short voiceless geminate in the words *outidi* 'cars, PPl' and *kõ'tõgid* 'lose, Imp2Pl' (*kõ'tõgõd* 'lose, JusPl' also belongs here). There are short vowels in the second and third syllable in these word types.

Table 4

Segment durations and syllable rhyme ratios in words
with a long first stressed syllable containing a geminate
and a short second and third syllable vowel
(PF = phrase-final, SF = sentence-final, N = number of words,
CC = geminate, * = duration of the diphthong)

Word	Position	N	V1	CC	V2	C	V3	S1/S2	S2/S3
<i>li'ggõgõd</i>	PF	12	111	197	72	102	99	3.00	0.77
	SF	12	104	213	75	104	88	3.07	0.86
	Mean	24	108	205	73	103	93	3.03	0.82
<i>outidi</i>	PF	6	283*	134	84	89	114	4.20	0.74
	SF	5	244*	170	77	96	110	4.35	0.81
	Mean	11	265*	150	81	92	113	4.27	0.78
<i>kõ'tõgid</i>	PF	9	223	153	70	88	106	4.55	0.66
	SF	8	212	164	68	105	98	4.59	0.70
	Mean	17	218	158	69	96	102	4.57	0.67

Here too, V2 is always shorter in duration than V3 (the difference between V2 and V3 is significant [$F(1,102) = 35.41, p < 0.001$]). The mean S2 vowel duration (V2) in word structures presented in Table 4 is between 69 and 81 ms, while the mean S3 vowel duration (V3) is between 93 and 113 ms.

The mean duration of a long voiced geminate in words like *li'ggõgõd* is 205 ms, being shorter in duration than the geminate in disyllabic words like *mä'ggõl* (CC = 226 ms; Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 : 139). The mean duration of the short geminate in the word *outidi* is 150 ms. Duration of the short geminate in disyllabic words with the same S1 and S2 structure was 155 ms (Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 : 127). In the word *kõ'tõgid* the average short geminate duration is 158 ms. The duration of the short geminate in disyllabic words with the same S1 and S2 structure was 177 ms (Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 : 124). Thus in general, geminate durations are decreased in these trisyllabic words as compared to disyllabic words.

A comparison of duration ratios of the first and second syllable rhymes in trisyllabic words (presented in Tables 3 and 4) with disyllabic words with the same structure clearly shows that the syllable ratios are bigger in a trisyllabic foot. The S1/S2 rhyme duration ratio is the smallest in the words like *li'ggõgõd* (3.00 in phrase-final position and 3.07 in sentence-final position) and the biggest in *outidi* and *mõtlõbõd* (averages vary between 4.20–4.77). In trisyllabic words, the duration of S1 is longer in most cases and the duration of S2 is always shorter than in disyllabic words. In disyllabic words in read speech, the average S1/S2 in words like *mä'ggõl* 'mountain, AllSg', *outo* 'car' and *katlõ* 'cauldron, PSg' was between 2.5 and 3.3 (Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 : 127, 136, 139). This result confirms the role of foot isochrony in Livonian. The first primary-stressed syllable in trisyllabic words needs to be more stressed in order for the foot to achieve isochrony. Figure 2 illustrates the mean syllable rhyme durations in words with a long stressed first syllable followed by two unstressed syllables.

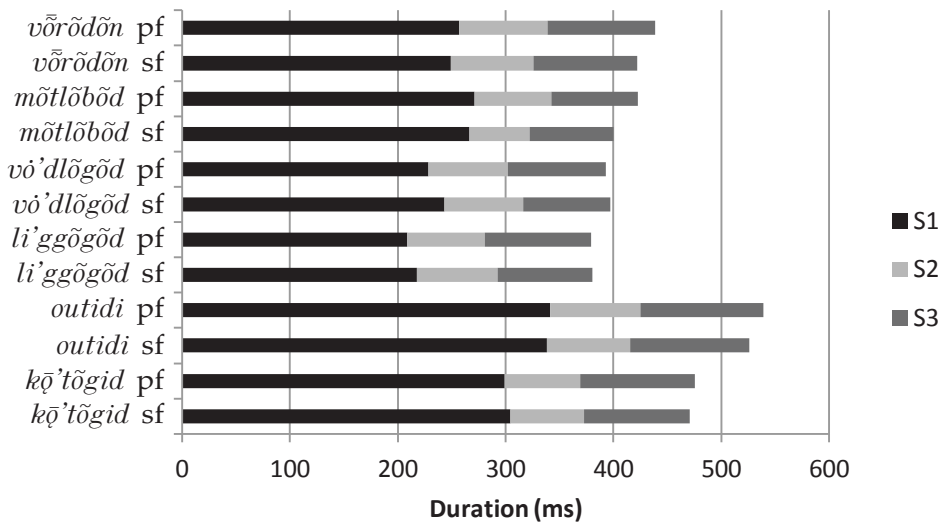


Figure 2. Mean syllable rhyme durations (ms) in words with a long stressed first syllable and short second and third syllable vowel (pf = phrase-final position, sf = sentence-final position).

The syllable durations in all six word types (presented in Tables 3 and 4, and Figure 2) discussed are relatively similar in phrase-final and sentence-final positions. There is no significant lengthening of the syllables in sentence-final words. The mean S1 rhyme duration is the longest in the word *outidi* (341 ms in phrase-final position and 338 ms in sentence-final position) and the shortest in *li'ggõgõd* (209 ms and 218 ms respectively).

Next, the segment durations in words with a long first syllable, a long voiceless geminate and a short third syllable vowel are presented in Table 5, i.e. *pu'nlikki* 'reddish' and *mõiznikkõ* 'squire, PSg'. Although both words contain a derivational affix, only *mõiznikkõ* has a secondary stress on the second syllable.

Table 5

Segment durations and syllable rhyme ratios in words with a long geminate (PF = phrase-final, SF = sentence-final, N = number of words, CC = long geminate, * = duration of the diphthong)

Word	Position	N	V1	C	C	V2	CC	V3	S2/S3
<i>pu'nlikki</i>	PF	8	124	118	80	89	183	104	2.05
	SF	7	110	119	106	82	204	97	2.22
	Mean	15	117	119	92	86	193	101	2.13
<i>mõiznikkõ</i>	PF	1	251*	113	70	78	174	97	1.77
	SF	1	270*	84	90	83	162	104	1.59

The average duration of the long geminate in the word *pu'nlikki* is 193 ms, shorter than the long geminate in disyllabic words with the same structure (in words like *akkõn* 'to catch, Pt' CC = 267 ms; Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 : 135). In the word *mõiznikkõ* the long geminate is shorter (174 and 162 ms) than in *pu'nlikki*. The S3 vowel durations in the word types of *pu'nlikki* and *mõiznikkõ* are similar to those in disyllabic words with the similar structure (S3 = 100 ms; Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 : 135).

Figure 3 represents syllable rhyme durations in the words *pu'nlikki* and *mõiznikkõ*.

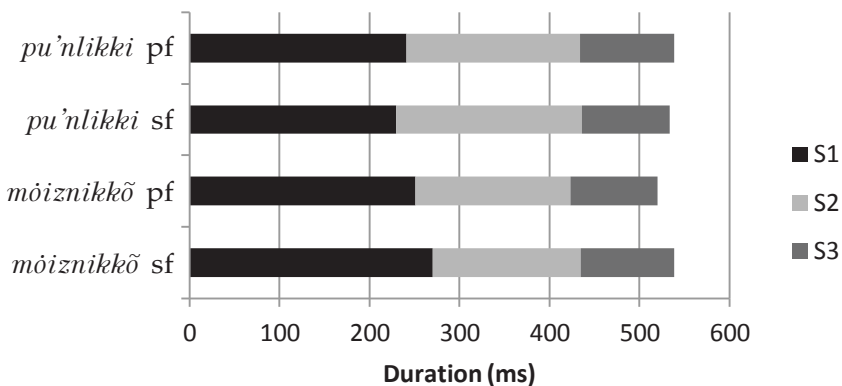


Figure 3. Syllable rhyme durations (ms) in words with a long geminate (pf = phrase-final position, sf = sentence-final position).

The mean S2/S3 differs in the two words. In *pu'nlikki* the syllable rhyme ratio is 2.05 in phrase-final position and 2.22 in sentence-final position. In *mõiznikkõ* the ratios are 1.77 and 1.59 respectively. This difference may be explained by the shorter S2 rhyme in the word *mõiznikkõ*.

Looking at the words (see Table 4) with stød (*kõ'tõgid*) and without stød (*outidi*), the duration of the stressed syllables in words with stød is shorter (218 ms) than the syllable duration in words without stød (265 ms). It is striking and also expected that the characteristic laryngealization only appears in the pronunciation of older speakers. However, the duration of the first stressed syllable in the word *kõ'tõgid* 'lose, Imp2Pl' is always greater in the pronunciation of older speakers. This result is not in line with the fact that the syllables carrying stød are shorter in duration and needs further investigation.

4.2. Secondary-stressed feet in tetrasyllabic words

The syllable structure of the secondary-stressed feet served as a criterion for dividing tetrasyllabic words into three groups. In the following, the results from the analysis of secondary-stressed feet will be presented. Secondary-stressed feet have the following structures in the test words: (1) CV.CVC(C) (e.g. *saländõbõd* 'they steal'), (2) CVC.CVC(C) (e.g. *puṛṛõnikä* 'sailboat'), and (3) CVC.CV(C) (e.g. *puṛṛõnikkõ* 'sailboat, PSg'). In tetrasyllabic words, there is a secondary stress on the third syllable. Again, an exceptional word here is *mõiznikädõn* 'squires, DPI', where there is a secondary stress on the second syllable of the word. A total of fifteen word structures will be discussed here.

First, the segment durations of the words with a short third syllable vowel and a half-long fourth syllable vowel such as *saländõbõd* 'they steal', *puṛṛõtõbõd* 'they sail' and *vã'grimizõks* 'with rolling, InISg' are given in Table 6. Secondary-stressed feet had the structure CV.CVC(C) in the test words.⁷

Table 6

Segment durations and syllable rhyme ratios of the secondary-stressed feet (PF = phrase-final, SF = sentence-final, N = number of words)

Word	Position	N	V3	C	V4	V3/V4
<i>saländõbõd</i>	PF	8	73	98	87	0.86
	SF	6	65	100	83	0.79
	Mean	14	69	99	85	0.83
<i>puṛṛõtõbõd</i>	PF	8	67	91	90	0.84
	SF	4	50	84	81	0.81
	Mean	12	66	96	89	0.83
<i>vã'grimizõks</i>	PF	1	85	89	68	1.25
	SF	1	105	91	83	1.27

The results of the current study are in line with previous findings (Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008). The second syllable vowel in the secondary-stressed foot in the word types of *saländõbõd* and *puṛṛõtõbõd*

⁷ Note that the half-long vowel in the secondary-stressed feet here is orthographically not indicated.

is always longer than the first syllable vowel. Compared to the primary-stressed CV.CV̇ words (Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 : 41), the vowels are significantly shorter (in a primary-stressed foot as in the word *kadüb* 'disappears', V1 = 103 ms and V2 = 211 ms).

The duration ratio of the vowels is greater in the secondary-stressed foot (0.79–0.86) and smaller in the primary-stressed foot (V1/V2 = 0.5; Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 : 41). Similar lengthening of the unstressed syllable in the secondary-stressed foot has also been observed in the pronunciation of the Saaremaa dialect of Estonian (Pajusalu, Help, Lippus, Niit, Teras, Viitso 2005 : 102). However, in Saaremaa the lengthening is greater in the secondary-stressed foot as compared to the primary-stressed foot, whereas in Livonian the lengthening is significantly bigger in the primary-stressed foot.

From the three word types presented in Table 6, the secondary-stressed foot of the word *vã'grimizõks* behaves somewhat differently. The situation is just the opposite of that seen in the words *salãndõbõd* and *pũrĩntõbõd*: V3 in the secondary-stressed foot is longer in duration and V4 is shorter (in phrase-final position 85 and 68 ms, in sentence-final position 105 and 83 ms), with S3/S4 of 1.25 and 1.27. The difference may be explained by the consonant cluster following the last vowel or the shortening of the unstressed vowel in this particular syllable structure.

The syllable rhyme durations in the words *salãndõbõd*, *pũrĩntõbõd* and *vã'grimizõks* are presented in Figure 4.

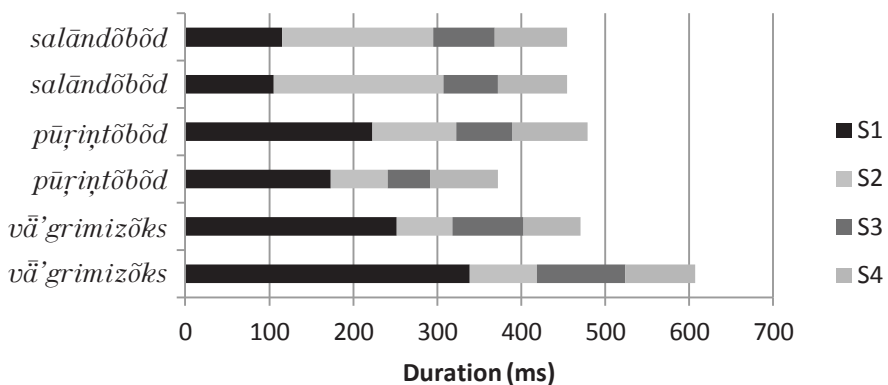


Figure 4. Syllable rhyme durations (ms) in words with a short S3 and half-long S4 (pf = phrase-final position, sf = sentence-final position).

Interestingly, there is a phrase-final lengthening in the word *pũrĩntõbõd*, but the situation is just the opposite in the word *vã'grimizõks*. This test word is significantly lengthened in sentence-final position, most likely due to the phenomenon of the lengthening of the final unit of an utterance or a phrase.

Syllable rhyme durations of the words with the affixes *-nikã* and *-lĩkĩz(t)* (a genitive and partitive case of the affix *-lĩkki*) are presented in Table 7, e.g. *pũrĩõnikã* 'sailboat', *irẽnikã* 'inhabitant of the Irẽ village', *vaļãnikã* 'cottager', *amãtnikã* 'official' and *pãvaļĩkĩz(t)* 'sun, GSg (PSg)'. The secondary-stressed foot has the structure CVC.CV̇C(C) and contains a short geminate. The word *mõiznikãdõn* 'squires, DPI' with the affix *-nikã* has a secondary stress on the second syllable and is therefore treated separately (see Table 8).

Table 7

Segment durations and syllable rhyme ratios of the secondary-stressed feet
(PF = phrase-final, SF = sentence-final, N = number of words)

Word	Position	N	V3	C	V4	S3/S4
<i>irēnikā</i>	SF	1	76	144	199	0.75
<i>vaļānikā</i>	PF	1	80	129	197	0.65
	SF	1	79	134	195	0.68
<i>amātnikā</i>	SF	1	83	145	181	0.87
<i>pāvaļikīz(t)</i>	PF	7	92	148	184	0.86
	SF	6	86	132	179	0.87
	Mean	13	90	141	182	0.87
<i>puŗŗōnikā</i>	PF	4	71	126	197	0.60
	SF	7	81	129	203	0.69
	Mean	11	78	128	201	0.66

The duration of the short geminate in the secondary-stressed foot is generally 126–148 ms and the duration of half-long V4 is 179–203 ms. These durations are generally a little longer than the respective durations in the two first syllables in the trisyllabic words *tikādōn* and *vikātōks* (cf. Table 1). The S3/S4 rhyme ratios tend to be bigger in words with the affix *-nikā* (for *tikādōn* and *vikātōks* the ratios were 0.50 and 0.59). The average ratio of syllable rhymes in the primary-stressed disyllabic foot with the same structure is similar: S1/S2 = 0.7–0.8 (Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 : 57). However, the syllable durations are slightly bigger in disyllabic feet: the S1 is 162 ms and S2 is 207 ms.

Table 8

Segment durations and syllable rhyme ratios in words with a long geminate
(PF = phrase-final, SF = sentence-final, N = number of words,
* = duration of the diphthong)

Word	Position	N	V1	C	C	V2	C	V3	C	V4	S2/S3	S3/S4
<i>mōiznikādōn</i>	PF	1	254*	79	58	78	117	195	81	81	0.59	2.41
	SF	1	204*	58	67	86	127	176	56	54	0.76	3.26

A comparison of the affix *-nikā* in the trisyllabic word *mōiznikā* (cf. Tables 2) and tetrasyllabic *mōiznikādōn* shows that the half-long vowel is lengthened considerably in the tetrasyllabic word. The S3 vowel duration in the trisyllabic word *mōiznikā* was 130 ms in phrase-final position and 147 ms in sentence-final position and in the tetrasyllabic word *mōiznikādōn* 195 and 176 ms. The duration of the short geminate in trisyllabic and tetrasyllabic words is similar. The S2/S3 ratios are 0.87 and 0.78 in trisyllabic words, and 0.59 and 0.76 in tetrasyllabic words.

Figure 5 presents syllable rhyme durations in the words with the affixes *-nikā* and *-likīz(t)*.

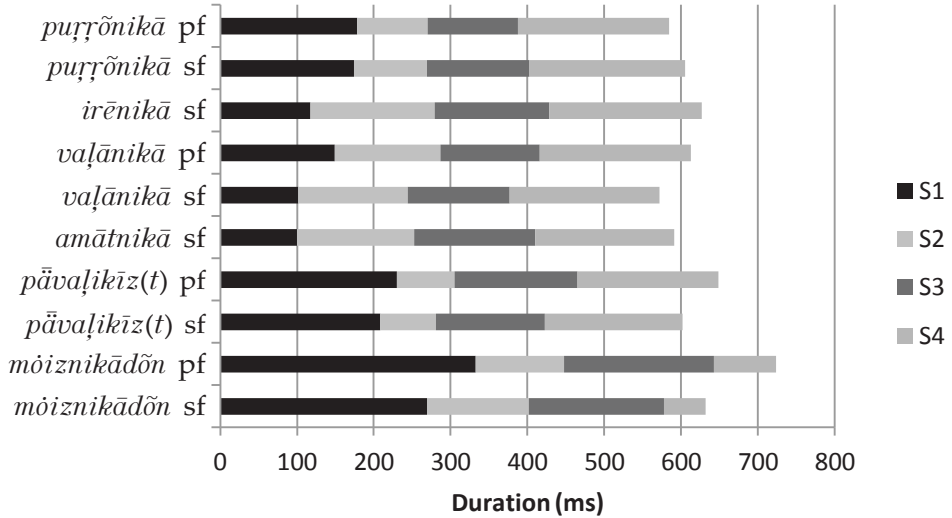


Figure 5. Mean syllable rhyme durations (ms) in words with the affixes *-nikā* and *-ļikīz(t)* (pf = phrase-final position, sf = sentence-final position).

Segment durations and duration ratios in the words with a long voiceless geminate followed by a short vowel in the secondary-stressed feet such as *pāvaļikki* 'sun' (the word *mōmaļikki* 'ladybird' also belongs to this type), *kumāļikki* 'camomile', *pāvaļikkīz(t)* 'sun, NPI', *mōmaļikkīz(t)* 'ladybird, NPI' and *puṛṛõnikkõ* 'sailboat, PSg' are presented in Table 9. The structure of the secondary-stressed foot here is CVC.CV(CC).

Table 9

Segment durations and syllable rhyme ratios of the secondary-stressed foot (PF = phrase-final, SF = sentence-final, N = number of words, CC = long geminate)

Word	Position	N	V3	CC	V4	S3/S4
<i>pāvaļikki</i>	PF	9	109	215	106	2.55
	SF	11	102	211	116	2.30
	Mean	20	105	213	112	2.41
<i>kumāļikki</i>	SF	1	77	168	102	1.62
	SF	1	68	183	91	1.98
<i>pāvaļikkīz(t)</i>	SF	1	69	150	60	2.48
<i>mōmaļikkīz(t)</i>	SF	1	81	181	77	2.48
	SF	1	99	179	81	2.56
<i>puṛṛõnikkõ</i>	PF	5	74	225	98	2.45
	SF	5	67	274	88	3.10
	Mean	10	70	249	93	2.78
<i>vaļānikkõ</i>	PF	1	88	176	88	2.09

The duration of the long geminate in a secondary-stressed foot is the longest in the word *puṛṛõnikkõ* (249 ms), which is approximately twice as long as the short geminate in the word type of *puṛṛõnikā* (128 ms). The S4 vowel duration in the secondary-stressed foot is the longest in the word *pāvaļikki* (112 ms), which is almost the same in duration as in the primary-stressed feet with the same structure (100 ms; Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 : 135). The S4 vowel is the shortest in words ending with a consonant cluster (60, 77 and 81 ms).

Mean syllable rhyme durations in words with a long geminate in the secondary-stressed foot are shown in Figure 6.

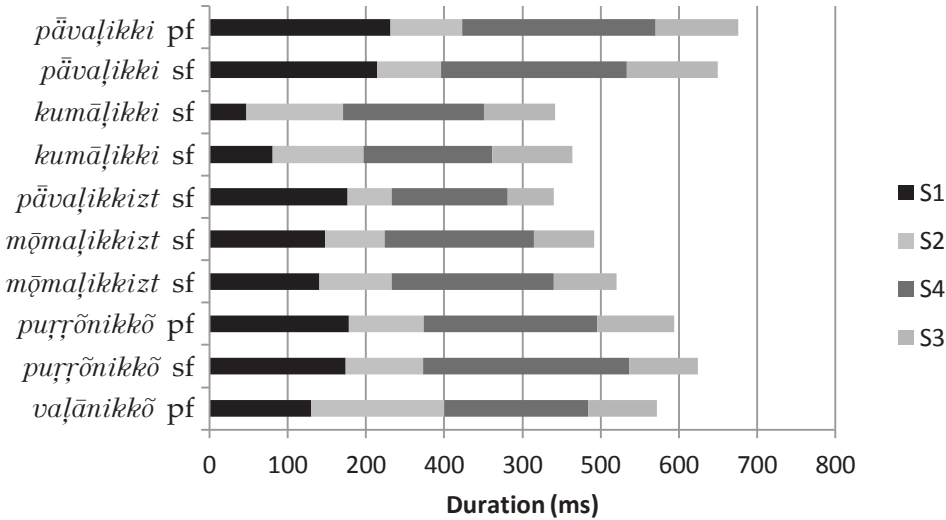


Figure 6. Mean syllable rhyme durations (ms) in words with a long geminate in the secondary-stressed foot (pf = phrase-final position, sf = sentence-final position).

Excluding the words that occurred only once, the average S3/S4 duration ratios remain between 2.30 and 3.10. The average ratio of the syllable rhymes in the primary-stressed disyllabic foot with the same structure was S1/S2 = 3.1 (Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 : 135). Thus, it can be concluded that syllable ratios in primary-stressed disyllabic feet and secondary-stressed disyllabic feet are similar.

In secondary-stressed feet where the geminate is long and the second syllable vowel is short, the S3/S4 rhyme duration ratios vary the most (1.62–3.10), with an average value of 2.55. The ratios vary because of the differences between speakers. Some speakers tended to lengthen long geminates considerably and thereby shorten the S4 vowel. The average S3 rhyme duration varies between 148 and 250 ms, being the shortest in the words *pāvaļikkizt* (148 ms) and *kumāļikki* (165 and 180 ms) and the longest in the words *pāvaļikki* and *puṛṛõnikkõ* (208–250 ms).

The S4 vowel duration in all structures of secondary-stressed feet would suggest the vowel in words *salāndõbõd* and *pūṛintõbõd* to be short and in words like *puṛṛõnikā* long (instead of calling them half-long). The S4 vowel in the words *salāndõbõd* and *pūṛintõbõd* (V4 = 85 and 89 ms, cf. Table 6) is less than half as long as the S4 vowel in words like *puṛṛõnikā* (V4 = 201 ms, cf. Table 7).

4.3. Secondary-stressed feet in pentasyllabic words

In pentasyllabic words there is a secondary stress on the third syllable. Altogether five word structures were analyzed. The secondary-stressed segment durations of the words *pāvaļikīzõ(n)* 'sun, IllSg (DSg)', *puŗŗõnikādõks* 'sailboat, InlPI', *vaļānikādõn* 'cottagers, DPl', *kumāļikīzõn* 'camomile, DSg' and *kēratimizõn* 'writing, DSg' are presented in Table 10. The main structure of the secondary-stressed foot here is CVC.CV̇.CVC(C).

Table 10

Segment durations and syllable rhyme ratios of the secondary-stressed foot
(PF = phrase-final, SF = sentence-final, N = number of words)

Word	Position	N	V3	C	V4	C	V5	S3/S4
<i>pāvaļikīzõ(n)</i>	PF	8	95	143	197	87	121	0.88
	SF	6	89	146	205	108	104	0.87
	Mean	14	93	145	201	96	113	0.87
<i>kumāļikīzõn</i>	SF	1	68	130	89	101	88	1.33
<i>puŗŗõnikādõks</i>	PF	4	52	109	160	76	55	0.54
	SF	5	80	117	182	95	65	0.66
	Mean	9	68	113	172	86	60	0.60
<i>vaļānikādõn</i>	PF	1	80	127	170	63	81	0.75
	SF	1	107	121	176	74	95	0.84
<i>kēratimizõn</i>	SF	1	70	69	139	111	87	0.50
	PF	1	59	97	97	126	132	0.61

The V4 duration is the longest in the word *pāvaļikīzõ(n)* (201 ms), which is longer than the V4 duration in the tetrasyllabic word *pāvaļikīz* (182 ms). The short geminate duration in the secondary-stressed feet is the longest in the word *pāvaļikīzõ(n)* and shortest in *puŗŗõnikādõks*. In tetrasyllabic words such as *pāvaļikīzt* and *puŗŗõnikā* the same tendency appeared. The duration of the short geminate in trisyllabic words (like *tikādõn* and *vikātõks*) was similar to that in pentasyllabic words. The duration of the last syllable vowel is the shortest in the word *puŗŗõnikādõks* (V5 = 60 ms), which is probably due to the following voiceless consonant cluster. In other word types the average V5 duration remained between 81 and 132 ms.

The analysis of the secondary-stressed foot reveals that the words *kēratimizõn* and *kumāļikīzõn* behave a little differently from other pentasyllabic words presented in Table 10. The average V4 duration in the secondary-stressed foot is usually between 160 and 205 ms, which is similar to that in the tetrasyllabic word type *puŗŗõnikā* (V4 = 187 ms). The S3/S4 ratio in the secondary-stressed foot is 0.54–0.88. However, the measurements of the word *kumāļikīzõn* (in sentence-final position) show that there is no lengthening of the S4 vowel in the secondary-stressed feet in this word. The duration of V4 is only 89 ms and the S3/S4 ratio is 1.33. This exception may be regarded as a fluke, reflected in only one test word, but could also be explained by the background of the speaker whose data contained this word. This female

speaker spoke Estonian to her mother. The test word was the last word of the triplet. In order to test whether this is a persistent pattern, the measurements of the first and second word of the triplet were included as well. The results are the same: V4 durations are 81 ms and 93 ms, the S3/S4 is 1.69 and 1.23. Thus the difference is valid here as well. Also, the word *kēratimizõn* has somewhat shorter V4 durations — 139 ms in phrase-final position and 97 ms in sentence-final position, having the S3/S4 0.50 and 0.61.

The syllable rhyme durations in pentasyllabic words are presented in Figure 7.

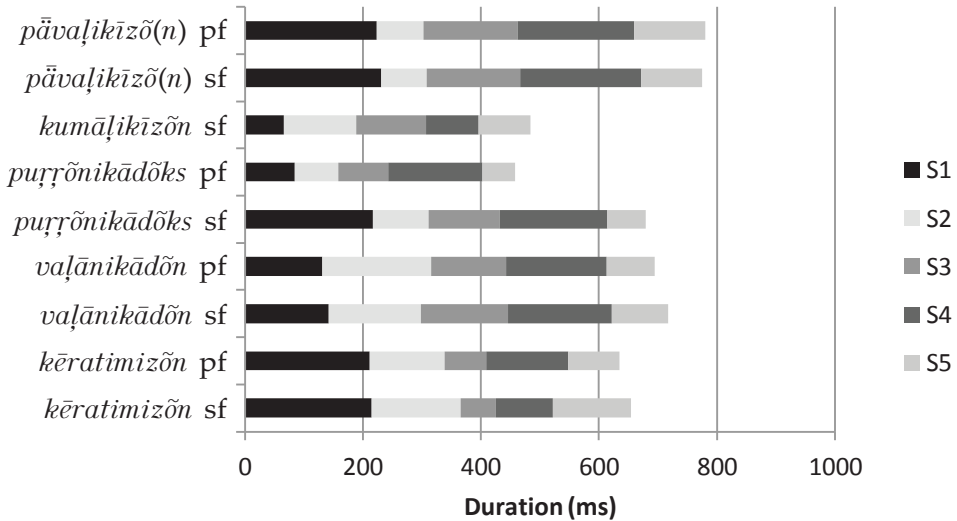


Figure 7. Syllable rhyme durations (ms) in pentasyllabic words (pf = phrase-final position, sf = sentence-final position).

In general, the syllable rhyme durations are similar in phrase-final and sentence-final position. Only the word *puṛṛõnikādõks* is considerably lengthened in sentence-final position.

The comparison of the primary-stressed feet of trisyllabic words (*tikādõn* and *vikātõks*, cf. Table 1) and secondary-stressed trisyllabic feet of five-syllable words with the same structure (*pāvaļikīzõ(n)* and *puṛṛõnikādõks*) reveals shortening of the secondary-stressed foot in the word *puṛṛõnikādõks*, while in *pāvaļikīzõ(n)* the foot is not shortened. The overall average S3/S4 syllable rhyme ratios in the word *puṛṛõnikādõks* and S1/S2 ratios in the trisyllabic words are 0.50–0.66, but in the word *pāvaļikīzõ(n)* the S3/S4 ratios are 0.87–0.88. The difference can be explained by the longer S3 duration in the word *pāvaļikīzõ(n)*. The analysis of the derivational affix *-nikā* shows that the S3 rhyme in the pentasyllabic words is similar to that found in the tetrasyllabic words (127–148 ms). This indicates that the two derivational affixes may behave differently in pentasyllabic words.

Conclusions

The aim of this paper was to study Livonian trisyllabic, tetrasyllabic and pentasyllabic words with different structures, with a focus on non-initial syllables and secondary-stressed feet. It was hypothesized that the dura-

tion ratios of the secondary-stressed feet are similar to those of the primary-stressed feet in Livonian, but there is a larger tendency to shorten the secondary-stressed feet. The results show that in tetrasyllabic words in Livonian, the syllable ratios of the secondary-stressed feet consisting of a long first syllable and short second syllable ($S1/S2 = 2.30-3.10$) are similar to those of the primary-stressed feet ($S1/S2 = 3.1$). The syllable ratios of the secondary-stressed feet consisting of a short first syllable and short or half-long second syllable in tetrasyllabic words are greater ($S1/S2 = 0.83$) than those of the disyllabic primary-stressed feet ($S1/S2 = 0.5$). The unstressed syllable is lengthened significantly more in a primary-stressed foot than in a secondary-stressed foot, while in Estonian the situation may also be the opposite. In Livonian pentasyllabic words the situation may differ depending on the structure of the secondary-stressed feet. The syllable ratios in trisyllabic secondary-stressed foot ($S1/S2 = 0.60$) are similar to the ratios in primary-stressed foot ($S1/S2 = 0.59$) if the secondary-stressed foot contains the derivational affix *-nikā*.

There is one particular pattern that is evident in trisyllabic words with a long initial syllable followed by a short second and third syllable vowel. Namely, the vowel duration in S2 is always shorter than the vowel duration in S3. The assumption that the lengthening of unstressed syllables is not a regular pattern and is valid only in certain word structures appears to be true. The results on geminates show that the short geminate duration is similar in disyllabic and longer words. However, long geminates are significantly longer in duration in disyllabic words than in longer words. The duration of the long geminate in tri- and tetrasyllabic words is approximately 1.5 times longer than that of a short geminate.

Words with derivational affixes were also treated separately. The affix *-nikā* functions as an independent word and behaves similarly in trisyllabic, tetrasyllabic and pentasyllabic words. The syllable ratios in the affix were the biggest in trisyllabic words, which may be explained by a shorter half-long vowel duration than that found in tetra- and pentasyllabic words. In the partitive case (*-nikkō*), the syllable durations were greater in tetrasyllabic words.

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ТУУЛИ ТУЙСК (Тарту)

**ТЕМПОРАЛЬНАЯ СТРУКТУРА
ТРЕХ-, ЧЕТЫРЕХ- И ПЯТИСЛОЖНЫХ СЛОВ В ЛИВСКОМ ЯЗЫКЕ**

Автор рассматривает трех-, четырех- и пятисложные слова ливского языка, сопоставляя темпоральную структуру непервых слогов и такта с второстепенным ударением. Длительности и их соотношения у слов с разными структурами анализируются на основе фонетического материала, записанного у носителей языка трех разных поколений. Результаты трехсложных слов показывают, что удлинение безударных слогов встречается только в определенных структурах слов. В таких структурах трехсложных слов, где за долгим первым ударным слогом следуют два слога с безударными гласными, гласный третьего слога всегда длиннее гласного второго слога. Анализ четырехсложных слов показал, что соотношение слогов в речевом такте второстепенного ударения в большинстве случаев похоже на соотношение ударного и безударного слогов в такте с главным ударением. В пятисложных словах трехсложный такт с второстепенным ударением похож на трехсложный такт с главным ударением только в том случае, когда в такте с второстепенным ударением присутствует деривационный аффикс *-nikā*. Этот аффикс по сути ведет себя как самостоятельное слово.