

TUULI TUISK (Tartu)

TONAL AND TEMPORAL CHARACTERISTICS OF DISYLLABIC WORDS IN SPONTANEOUS LIVONIAN*

Abstract. The article focuses on the study of Livonian word prosody and deals primarily with the role of quantity and tone and their phonetic realization. One of the purposes of this paper is to carry out an investigation of the realization of the temporal and tonal characteristics of words consisting of a short first syllable and a half-long second syllable (CV.C \check{V} structure) in spontaneous speech. An acoustic-phonetic analysis of the recordings of spontaneous speech by four speakers was carried out. In addition, the interaction between pitch alignment and durational changes in three structures of disyllabic words is analyzed.

Keywords: Livonian, word prosody, quantity, pitch alignment.

Introduction

The current paper focuses on Livonian quantity and tonal system. The paper deals with the Courland Livonian spoken on the Livonian Coast in Latvia.

The Livonian prosodic system has been quite thoroughly studied during the past years. Extensive work has been carried out within the project investigating the prosody of Finno-Ugric languages. The aim of this project is to analyse lesser-known Finno-Ugric languages using modern experimental tools of acoustic phonetics (Lehiste, Pajusalu 2010). The project has so far dealt with the study of Erzya, Meadow Mari and Livonian (2003, 2005, 2008 respectively). The investigation of Moksha prosody is in progress (see for example Aasmäe, Pajusalu, Zirnask 2011). The initiator of the study of the prosody of Finno-Ugric languages at the University of Tartu was the late Professor Ilse Lehiste.

The Livonian prosodic system has similarities to that of Estonian as well as Latvian. In Livonian, primary stress is fixed, falling on the first syllable of a word. The tonal system is similar to Latvian. There is a tone opposition in the primary stressed syllable. Like Latvian, Livonian uses stød as one of its prosodic features (for Latvian, cf. Markusa 1991). Words

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pronounced with *stød* are often referred to as words with broken tone, and words without *stød* as words with plain or rising tone.

The quantity system of Livonian has similarities with that of Estonian (for Estonian, see Lehiste 1960; 1997; for Livonian, cf. Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008). The domain of the Estonian quantity is a primary stressed disyllabic foot, and one of the main features characterizing the quantity opposition is the duration ratio of the syllables in the foot. In Livonian, there are metric feet that correspond to Estonian Q1 metric feet, where there is a short first syllable and a half-long second syllable, for example words like *kadāg* 'juniper', *sadāb* 'it rains' (the syllable ratios are 0.5–0.7, Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008). There are two kinds of metric feet containing a long first syllable in Estonian — one with a half-long second syllable, and another with a short second syllable. In the studies on Livonian prosody also a set of words have been found where the half-long vowel occurs in the second syllable of a foot that has a long vowel or long diphthong in the first syllable, for example words like *nōļa* 'joke', *lēba* 'bread' (Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008; Tuisk, Teras 2009). The durational ratios of the first type correspond to those of Estonian Q2 (the syllable ratios are 1.0–1.8, Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008), and those of the second type — long syllable followed by a short syllable — correspond to Estonian words in Q3, for example words like *kōrōd* 'wheels', *āiga* 'time' (syllable ratios 2.4–3.2, Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008). In Livonian orthography both the half-long vowel and the long vowel are marked with a length mark — a macron above the vowel letter. In Estonian orthography, both the long vowel and the overlong vowel are spelled with two identical letters, the half-long vowel is spelled with only one letter. There is also a tendency towards foot isochrony in Livonian, similarly to Estonian.

Half-long vowel in the second unstressed syllable

The question of a half-long second syllable in Livonian has attracted attention since the beginning of the 20th century. Already in 1925 Lauri Kettunen pointed to the fact that if the vowel of the first syllable is short and is followed by a short consonant or a weak (or in other words short) geminate, the vowel of the second syllable is half-long: *ižà* 'father', *oḗpùB* 'he/she studies' (Kettunen 1925).

According to Lauri Posti a half-long vowel can occur in the second or fourth syllable of the word if the vowel of the preceding stressed syllable is short and the intervocalic consonant has a short quantity (Posti 1936). Also, it is possible for *stød* to occur in an unstressed half-long vowel. According to Posti this is only true for Eastern Livonian. In Western Livonian, there is no *stød* in the vowel of the second syllable, which in Posti's opinion is related to the fact that the vowel of the first syllable in Western Livonian is slightly longer than the first syllable vowel in Eastern Livonian. In front of a voiced consonant, the first syllable seems even longer than in front of a voiceless consonant. This stretching of the first syllable causes the vowel in the second syllable in Western Livonian to be shorter than that in Eastern Livonian.

Hille Pajupuu and Tiit-Rein Viitso have studied Livonian polyphthongs (Pajupuu, Viitso 1986). They claim that similarly to Estonian in Livonian there exists an inverse proportionality between the vocalisms of the second and the first syllable: a (half-)long vowel in the unstressed second syllable appears only in words with a short polyphthong in the preceding syllable.

It is already mentioned above that Livonian is one of the languages investigated in an ongoing study of Finno-Ugric prosody. As some data from this study concerning the half-long vowel will be used in the current paper, a brief detailed overview of the results presented in Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 will hereby be given. It should be kept in mind that data in this study consists of test words extracted from read sentences.

Thus, the CV.C \ddot{V} structure in Livonian represents words with a first syllable containing a short monophthong and a short diphthong, and with a second syllable containing half-long vowel (\ddot{V}). Examples of this type of words are: *kadūb* 'disappears', *tubā* 'room', *vedā* 'drag/pull (Imp2Sg)'. Words of this type have a longer vowel in the second syllable than in the first syllable. Both the short vowel and the short diphthong are followed by a second syllable of the same kind of half-long duration.

Vowel durations, standard deviations and V1/V2 duration ratios in CV.C \ddot{V} type of words are presented in Table 1.

Table 1

Vowel durations (in ms), standard deviations and V1/V2 duration ratios in disyllabic CV.C \ddot{V} and C \ddot{V} .C \ddot{V} words produced by 8 speakers (V \ddot{V} — short diphthong = V1 in the table, N — number of occurrences)

CV.C \ddot{V}					
Position	N	V1	V2	V1/V2	Foot
PF	19	107	218	0.5	410
		10	31		53
SF	19	100	203	0.5	393
		15	24		28
Overall average	38	103	211	0.5	401
		12	28		42
C \ddot{V} .C \ddot{V}					
Position	N	V1	V2	V1/V2	Foot
PF	9	142	222	0.6	453
		25	38		42
SF	10	149	200	0.7	451
		39	32		66
Overall average	19	146	210	0.7	452
		32	35		54

Data for short vowels and short diphthongs are presented separately. As can be seen, a short diphthong is on an average 43 ms longer than a short vowel (the difference is statistically highly significant at the $p < 0.0001$ level). Second syllable durations are practically identical (211 and 210 ms), and the duration ratios are similar — on average 0.5 and 0.7. This word

structure resembles an Estonian word in the short quantity ($V1/V2 = 0.6$, see Lehiste 1997), where the second syllable is half-long (\check{V}).

Average fundamental frequency values of $CV.C\check{V}$ and $C^V.V.C\check{V}$ words are presented in Table 2.

Table 2

Average F0 values, the distance of F0 peak from the beginning of V1 (%), and standard deviations (Hz) in disyllabic words with a short open first syllable and a half-long second syllable vowel ($CV.C\check{V}$, $C^V.V.C\check{V}$ words) in phrase-final and sentence-final position (Phrase-final position: 2 male and 6 female speakers, sentence-final position: 2 male and 5 female speakers) (N — number of occurrences)

Position	Speakers	N	V1				V2	
			F0 beginning	F0 peak	F0 end	Peak %	F0 beginning	F0 end
PF	Male	6	168	191	186	75	175	116
			13	4	7	12	3	16
	Female	16	235	266	249	79	222	194
			26	22	20	7	20	17
SF	Male	7	176	179	160	21	140	94
			15	11	11	13	5	5
	Female	13	180	181	157	12	165	151
			11	12	7	3	7	10

Phrase-final words were mostly produced with a late F0 peak on the first syllable, and falling F0 on the second syllable. However, there were some exceptions between speakers. Sentence-final words were generally produced with an early F0 peak in the first syllable followed by an F0 fall. Again, some differences between speakers were detected.

There are also a number of words in Livonian where an open long first syllable is followed by a half-long vowel in the second syllable. In some of them the vowel of the second syllable is provided with a macron in spelling, but in some words the half-long vowel was found in words where the second syllable was not marked as long. The materials on read sentences contained two such words: *võrõz* 'stranger' and *kīraz* 'axe'. Words with a long open first syllable and a half-long second syllable vowel have a $V1/V2$ ratio of 1.7–1.8, and words containing a long open first syllable and a short second syllable vowel have a $V1/V2$ ratio of 2.3–2.6. These two word types are clearly distinguished on the basis of V2 duration and $V1/V2$ ratios. According to earlier results from spontaneous speech, there might also be a difference between speakers (Tuisk, Teras 2009). On the basis of the duration ratios some speakers differentiated the two types of words similarly to Estonian Q2 and Q3 words, while some did not.

Words with a long open first syllable included those containing a long diphthong as their first syllable nucleus. There was one word with a long diphthong (*aigā* 'shore') and a half-long vowel in the second syllable, spelled with a macron. In words where the second syllable vowel is half-long, the duration ratio of vowels was 1.0–1.1. A triphthong, too, can be the nucleus of a long open first syllable. There was one word with a triphthong in the

first syllable and a half-long vowel in the second syllable, spelled with a macron (*kuoig̃d* 'ships'). Duration ratios in these word types were 1.0–1.2.

Research aims

The aim of this paper is to carry out an investigation of the realization of the temporal and tonal characteristics of the words consisting of a short first syllable and a half-long second syllable in spontaneous speech. Taking into account previous studies on Livonian quantity and tonal structure, it is hypothesized that temporal characteristics remain stable in spontaneous speech, while tonal characteristics are not as stable in spontaneous speech as in read speech.

Kari Suomi has studied durational and tonal correlates of accent in Finnish (Suomi 2005a; 2005b; 2007). According to him the motivation for certain durational changes is the fact that they help to achieve tonal uniformity. At a certain point all words have the same value. For example, comparing two Finnish word types, it is possible to claim that the differences in the durations of the second syllable in *setä* and *seiko* word types compensate for the differences in the first syllable durations (for details see Suomi 2005). The interaction between durational changes and tonal characteristics of the accent is signalled by the similar realisation of the accent in different word structures. One of the reasons for such an interaction between the segmental structure and the tonal rise-fall movement might be the fact that it helps to perceive the durational contrasts. Suomi gives another example by comparing such word types as *kato* and *kaato*. If the tonal movement in the first syllable is clearly rising-falling, the word is probably *kaato*, but if the movement is just rising, it is *kato*. Looking at the second syllable, if the tonal movement is somewhat lower and slightly falling, the word perceived is *kaato*. In the word type *kato*, there is a steep fall in the second syllable. In addition, the duration of the second syllable helps to distinguish these words. The duration of the second syllable is short in *kaato* and long in *kato*. As a consequence, if the first syllable is short, the second syllable gets lengthened, and this lengthening is in accordance with the location of the turning point of the fundamental frequency.

Taking into account all these observations similar tendencies in Livonian will be discussed.

Research material and method

The data from spontaneous speech used comes from the University of Tartu Archives of Estonian Dialects and Kindred Languages (<http://www.murre.ut.ee/archives-of-estonian-dialects-and-kindred-languages/>). Firstly, the material of disyllabic words with a short first syllable containing a half-long vowel in the second syllable will be presented. Examples of this word structure would be *nanā* 'nose', *jemā* 'mother', *jumāl* 'God'. The test words are from the spontaneous speech of four native Livonian speakers, who were recorded in the 1970s. Female speaker KK was born in 1889 (Kuoštrõg village), female speaker PŠ in 1880 (Kuoštrõg, born in Sīkrõg), male speaker JZ in 1904 (Vaid) and male speaker PD in 1909 (Sīkrõg). All three villages, Kuoštrõg, Vaid and Sīkrõg belong to the Eastern part of the Livonian Coast.

Only phrase-internal words were analyzed, as this position could be considered neutral. The words in this position formed the most complete set of data. All test words were in stressed position. The analyzed material consisted of 60 words.

The test words were manually tagged using PRAAT (Boersma, Weenink, 2011). The duration of each segment was extracted from the annotated TextGrid using a PRAAT script. The fundamental frequency measures were automatically taken at the beginning and end of each syllable. The location of the F0 and turning point relative to the beginning of the second syllable was also established and will be presented in percentages. By turning point, the point where there is a noticeable change in the direction of the F0 contour in V2 from rising or level to falling is meant. The correlation test was carried out with the statistics package R (version 2.14.0).

Secondly, the material of disyllabic words from spontaneous speech with a long first syllable containing a half-long or a short vowel in the second syllable will be used and presented together with similar material from the read sentences (the material has previously been presented in Tuisk, Teras 2009; Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 respectively). Examples of these word types would be *kīraz* 'axe' (referred to as Q2 words) and *sōdō* 'to get' (referred to as Q3 words). Words with *stød* were not analyzed.

Results and discussion

The mean vowel durations, standard deviations and duration ratios in accented CV.CV̆ words are presented in Table 3. Only the words with a short monophthong in the first syllable were included in the analysis.

Table 3
Vowel durations (in milliseconds), standard deviations and V1/V2 duration ratios in disyllabic CV.CV̆ words produced by 4 speakers (N — number of occurrences)

Speaker	N	V1	V2	V1/V2	Foot
KK	15	81	145	0.56	283
		22	18		47
PŠ	12	77	146	0.53	283
		24	17		44
PD	17	92	193	0.49	353
		17	34		43
JZ	16	95	166	0.58	319
		19	30		51
Overall average	60	87	164	0.54	312
		21	33		54

The results are somewhat similar to the ones of Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008 (see Table 1). The duration of the first syllable is 87 ms and the second syllable 164 ms (103 ms and 211 ms in read speech respectively). The durational structure here is clearly comparable to

that of Estonian. Still, there is a slight difference compared to the results from spontaneous speech in Estonian. In Asu, Lippus, Teras, Tuisk 2009 and Lippus, Asu, Teras, Tuisk 2011 is studied the realization of Estonian quantity characteristics in spontaneous speech. In Estonian, the mean V1 duration was about 60–70 ms and V2 duration about 80 ms in Q1. Thus, the duration of the second syllable in Livonian is twice as long as in Estonian. The duration ratios of the syllables remain between 0.49 and 0.58 in Livonian, which is similar to the ratios presented in Lehiste, Teras, Ernštreits, Lippus, Pajusalu, Tuisk, Viitso 2008. Thus, durations of the syllables and duration ratios remain stable both in read speech and spontaneous speech. In spontaneous Estonian, average ratio of the syllables for Q1 is about 0.7.

In Table 4 average F0 values (in Hz) and standard deviations of the same word type are presented. The results of the fundamental frequency measurements reveal interesting tendencies.

Table 4

Average F0 values (Hz), the distance of F0 turning point from the beginning of V2 (%), and standard deviations in disyllabic CV.CV̇ words in phrase-internal position (N – number of occurrences)

Speaker	N	V1		V2			
		F0 beginning	F0 end	F0 beginning	F0 TP	F0 end	TP %
KK	15	224	228	246	248	193	13
		31	35	39	40	27	10
PŠ	12	271	285	318	318	232	14
		40	36	52	52	39	14
PD	17	109	113	118	119	95	20
		5	9	7	8	12	15
JZ	16	174	189	198	198	153	6
		25	27	26	26	35	8

The contour of the fundamental frequency here is mostly level or slightly rising during the first syllable and falling in the second syllable. The turning point of the fundamental frequency is at the beginning of the second syllable. This is a rather intriguing situation, because the difference in the results between read speech and spontaneous speech arises. Location of the turning point was usually at the beginning or end of the first syllable of the word in case of read speech (see Table 2). In Figure 1 the pitch contours of the accented CV.CV̇ words are presented.

Similar situation is pointed out in the case of spontaneous Estonian, where the turning point in Q1 words is at the beginning of the second syllable (Lippus, Asu, Teras, Tuisk 2011). The results of the read sentences show that the turning point is towards the end of the stressed syllable in case of phrase-final position in Livonian (the distance of F0 turning point from the beginning of V1 is 75% and 79%). In case of the sentence-final position the turning point is at the beginning of the stressed syllable (21% and 12%). In spontaneous speech in Livonian, the distance of F0 turning point from the beginning of V2 is 6–20%. Perhaps, the difference in the location of the F0 turning point could be explained by the durational changes in the syllables, especially in the first syllable.

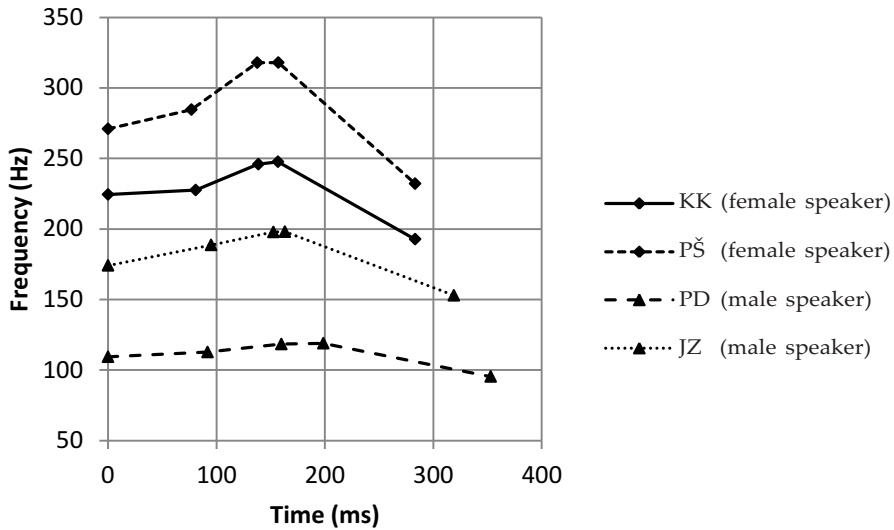


Figure 1. Pitch contours of the CV.CV̇ word structure in spontaneous speech. The five measurement points are taken (1) at the beginning of V1, (2) at the end of V1, (3) at the beginning of V2, (4) at the turning point, and (5) at the end of V2.

Also, the duration of the second syllable plays an important role. A correlation test was performed to see if there is a correlation between the duration of the second syllable and the location of the turning point. The test showed that the correlation is positive ($r = 0.383$) and statistically significant ($p < 0.01$). This suggests that a longer V2 duration is closely related to a late F0 turning point.

Next, the overall contours of the fundamental frequency of the three word structures are presented. The example words in the figures will serve to represent their respective word types (*jemā* 'mother' referred to as Q1 structure, *kīraz* 'axe' referred to as vocalic Q2 structure, and *sōdō* 'to get' referred to as vocalic Q3 structure). The results of the read speech and the spontaneous speech are presented in separate figures. In Figure 2, only the results of phrase-final test words are presented. In spontaneous speech (see Figure 3) two types of F0 turning point location appeared in words similar to Estonian Q3, and are referred to as *sōdō* I and *sōdō* II.

With some exceptions, the overall contours of the three word types somewhat support the idea of Kari Suomi about the tonal uniformity. The overall tonal contour is quite clearly rising-falling in most of the cases, despite the durational differences in both syllables. Average durational ratios of the syllables of the three word structures presented in Figures 2 and 3 are about 0.5 for the words similar to Estonian Q1, 1.7–2.2 for the words similar to Estonian Q2, and 2.4–3.2 for the words similar to Estonian Q3.

It seems that it would be appropriate to consider the concept of foot isochrony at this point. This is an important aspect which is similar in Estonian, where a longer first syllable is followed by a shorter second syllable, and vice versa, resulting in approximately equal durations of the S1 + S2 and S3 + S4 sequences (Ross, Lehiste 2001). Figures 2 and 3 illustrate the tendency to balance syllable durations in order to arrive at foot isochrony.

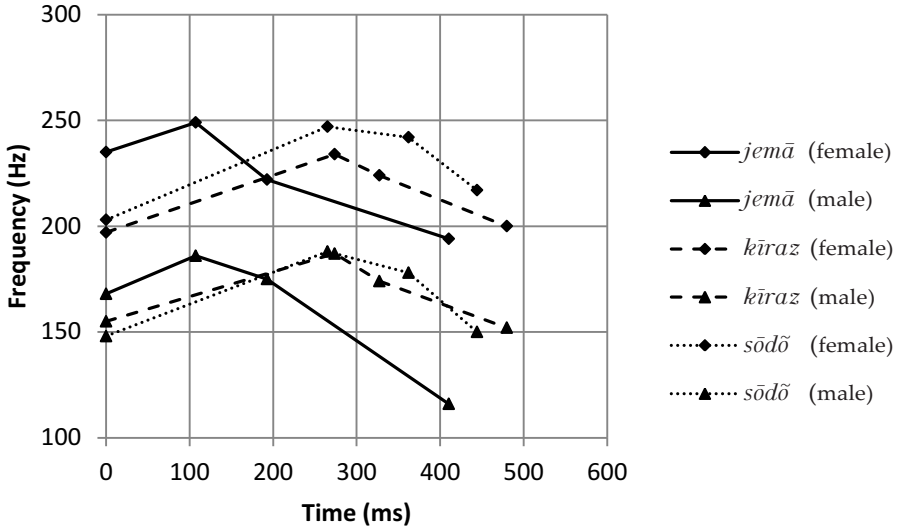


Figure 2. Pitch contours of the three word structures of disyllabic words in read sentences (both female and speakers). The four measurement points are taken (1) at the beginning of V1, (2) at the end of V1, (3) at the beginning of V2, and (4) at the end of V2.

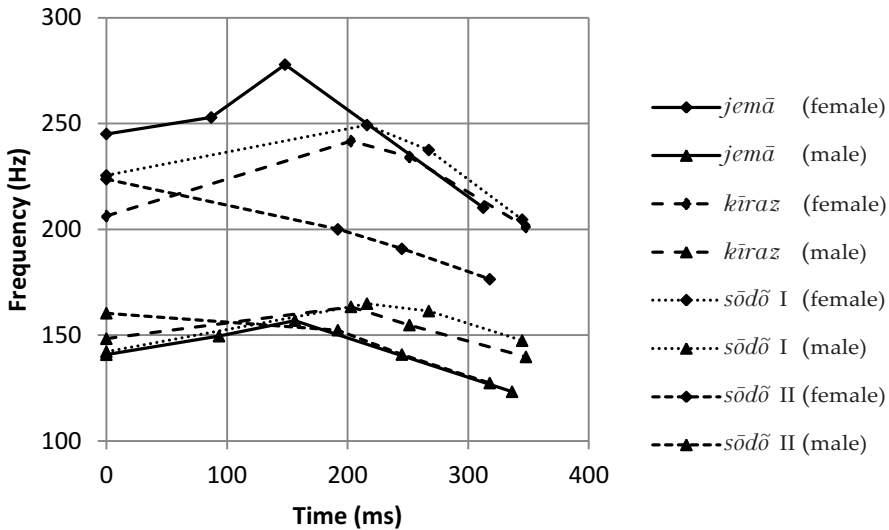


Figure 3. Pitch contours of the three word structures of disyllabic words in spontaneous speech (female and male speakers). The four measurement points are taken (1) at the beginning of V1, (2) at the end of V1, (3) at the beginning of V2, and (4) at the end of V2.

The results provide support for the claim by Suomi (2005a; 2005b) that like in Finnish, there seems to be a single overall F0 tune also in Livonian, irrespective of word structure, and that segment durations are adjusted in order to reach this uniform tonal goal. Yet, Suomi finds it somewhat paradoxical that in Finnish where the quantity opposition serves important contrastive functions, and where tonal properties have no corresponding function, segmental durations are nevertheless secondary to accentual tonal

purposes. In other words, a uniform tonal movement appears to be the primary goal, and segmental durations in different word structures vary extensively in order to guarantee that the uniform tonal goal is reached. In Livonian, the situation is perhaps not that surprising, as in the Livonian prosodic system both temporal and tonal features play a very important role.

Conclusion

The main aim of this paper was to give an overview of the role of duration ratios and fundamental frequency in spontaneous Livonian. The results of the analysis described in the present paper indicate that the prosodic structure of disyllabic Livonian words with a short first syllable and a half-long second syllable resembles that of Estonian disyllabic Q1 words. While the temporal characteristics appear to be stable both in read speech and spontaneous speech, the tonal characteristics show an interesting variation in the F0 turning point alignment.

The analysis of the interaction between the tonal alignment and durational changes in the three structures of disyllabic words confirmed a tendency towards foot isochrony in Livonian. Similarly to Finnish, the overall pitch contour of disyllabic words fit in the pattern of the tonal uniform in different word structures.

Address

Tuuli Tuisk
University of Tartu
tuuli.tuisk@ut.ee

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ТУУЛИ ТУЙСК (Тарту)

ТОНАЛЬНЫЕ И ТЕМПОРАЛЬНЫЕ СВОЙСТВА ДВУСЛОЖНЫХ СЛОВ В СПОНТАННОЙ ЛИВСКОЙ РЕЧИ

Статья посвящена просодии слова в ливском языке. Прежде всего рассматривается фонетическая реализация количества и тона. Одна из задач автора — в спонтанной речи выявить темпоральные и тональные свойства таких двусложных слов, в которых первый слог краткий, а второй полудолгий (структура CV.CV̆). Запись спонтанной речи четырех ливских информантов исследовалась в акустико-фонетическом аспекте. Результаты анализировались соответственно их роли в просодической структуре ливского языка. Кроме того, анализировались контур основного тона и взаимозависимость изменений длительности в двусложных словах трех разных структур.