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15

TUULI TUI SK

Livonian word prosody



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Livonian word prosody

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Dissertation is accepted for the commencement of the Degree of Doctor of Philosophy in Finnic languages on September 1st, 2015 by the Committee of the Institute of Estonian and General Linguistics, Faculty of Philosophy, University of Tartu

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Commencement: November 12th, 2015 at 12.15, room 139 in the University main building, Ülikooli 18, Tartu

This dissertation has been supported by the European Social Fund



ISSN 1406-2631
ISBN 978-9949-32-968-7 (print)
ISBN 978-9949-32-969-4 (pdf)

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University of Tartu Press
www.tyk.ee

PREFACE

At the beginning of my bachelor studies at the University of Tartu, I had no idea that I will end up researching and writing about Livonian prosody in the doctoral studies. I don't think I would have had such a connection to the Livonian language and linguistics in general if I didn't have so many inspiring and guiding people around me.

First of all, I would like to thank my supervisors. My very first contact with the Livonian language was in professor emer. Tiit-Rein Viitso's Livonian language courses. I am deeply grateful for his patience, helpful advice and trust. I have learned so much from him, not only about the field of the scientific research and the Livonian language, but also about the beliefs in life in general. It was Professor Karl Pajusalu who encouraged me to continue my studies at the university as a PhD student. His constant good-hearted support was very important. He contributed to my work with fruitful ideas, valuable advice and limitless energy. My supervisors' support and belief in me was extremely important at the times when I needed it the most.

It has been great to be part of the team in the phonetics lab at the Institute of Estonian and General Linguistics. I am very grateful to all my colleagues in the lab. I have learned so much from each one of them. My special thanks go to my co-author Pire Teras for reading and commenting my manuscripts. She has helped and encouraged me in so many ways. I am deeply grateful to Eva Liina Asu-Garcia for her valuable advice and guidance in writing my thesis. I really appreciate constructive comments and statistical support of Pärtel Lippus. I want to thank Ellen Niit for her help and useful remarks. Nele Salveste and Kätlin Aare have offered their help in commenting my writings. I would also thank Eva Liina Asu-Garcia and David Ogren for English language editing.

I am also indebted to several other people at the Institute of Estonian and General Linguistics. My former supervisor Tõnu Seilenthal encouraged me to continue my studies as an MA student and has always been very supportive during my studies. My thanks also go out to the coordinator Tiia Margus for assisting me in a variety of matters. And to Miina Norvik – during my doctoral studies she has been a very important companion in the field of the Livonian language and a dear friend with whom to discuss thousands of things. Her enthusiasm has been absolutely inspiring.

My studies have brought me together with wonderful people deeply interested in the Livonian language, culture and history. Meetings in different parts of the Livonian area have encouraged me in so many ways. Our seminars and workshops at the Livonian Coast have always been very fruitful and unforgettable. There are many kind people who have influenced my studies perhaps not even knowing it themselves. I would deeply like to thank Valts Ernštreits, who has always been and still is an inspiring role-model for me. He, Renāte Blumberga, Tapio Mäkeläinen, Baiba Damberga, Ulla Fraser, the late Tõnu Karma, and many others have created an amazing Livonian world for me. I am very grateful to all the late Livonian speakers who have participated in my

thesis. I have had an excellent chance to meet some of them and I am very grateful for that.

I am delighted and honoured that Professor Dace Markus and PhD Hille Pajupuu agreed to act as the reviewers of this thesis and made helpful comments.

As for official support, I have benefitted from the Institutional Research Project “Prosodic structure and language contact in the Finno-Ugric languages” (IUT2-37, 2013–2018), the Target Financed Research Programme “Phonetic, phonological, and morphophonological regularities of Finno-Ugric languages” (SF0180076s08, 2008–2012), Estonian Science Foundation grants No. 6528 and 6983. I have received support from the University of Tartu Doctoral School of Linguistics, Philosophy and Semiotics. I also wish to thank Alfred Kordelin’s Foundation, Archimedes Foundation, Kindred Peoples Programme and NordLing Foundation for the scholarships during my studies.

This thesis would not have been possible without the support of my family and friends. My dear parents Viivi and Arvet have helped me in so many ways and been always interested in my research. My aunt Pilvi has kindly offered her time when taking care of my daughter and constantly encouraged me during the studies. I would also like to thank Kadri, Kätlin and Triin – I greatly appreciate our friendship. My sincere thanks go to Ando, without whose support I wouldn’t have had this valuable free time to concentrate on my research and who patiently took care of all the work at home. Finally, there is one little girl who has lightened up my days and pushed me to pull together at all times – my daughter Adeele, whose smile and hugs mean more to me than I can put into words.

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LIST OF PUBLICATIONS

- [P1] Tuisk, Tuuli (2014). Survey of research on Livonian prosody. *Journal of Estonian and Finno-Ugric Linguistics* 5(1), 261–292.
- [P2] Tuisk, Tuuli & Pire Teras (2009). The Role of Duration Ratios and Fundamental Frequency in Spontaneous Livonian. *Linguistica Uralica* XLV 4, 241–252.
- [P3] Tuisk, Tuuli (2012). Tonal and Temporal Characteristics of Disyllabic Words in Spontaneous Livonian. *Linguistica Uralica* XLVIII 1, 1–11.
- [P4] Tuisk, Tuuli (2015). The Temporal Structure of Tri-, Tetra- and Pentasyllabic Words in Livonian. *Linguistica Uralica* LI 3, 177–195.
- [P5] Teras, Pire & Tuuli Tuisk (2009). The characteristics of stød in Livonian. In Martti Vainio, Reijo Aulanko, Olli Aaltonen (Eds.), *Nordic Prosody. Proceedings of the Xth Conference*, Helsinki 2008. Frankfurt: Peter Lang Verlag, 217–226.
- [P6] Tuisk, Tuuli (2015). Acoustics of stød in Livonian. In The Scottish Consortium for ICPHS 2015 (Ed.), *Proceedings of the 18th International Congress of Phonetic Sciences*. <http://www.icphs2015.info/pdfs/Papers/ICPHS0356.pdf>. Paper number 356. Glasgow, UK: the University of Glasgow, 1–5.

I. INTRODUCTION

I.1. Objectives

The Livonian language shares similar prosodic features with Finno-Ugric languages but also Baltic and Scandinavian languages. Its quantity system is above all similar to Estonian (Lehiste 1960, 1997a). A significant phenomenon in Livonian word prosody is the opposition of the pitch contour (Posti 1936; Vihman 1971; Viitso 1981). Livonian is the only Finnic language that differentiates between two contrastive tones in stressed stem-initial syllables. Such tone opposition is quite unusual for Finno-Ugric languages and together with the temporal aspects leads to the special position of Livonian among the languages spoken in the contact area around the Baltic Sea.

The current thesis focuses on three main research questions: (1) What is the role of quantity and fundamental frequency in the Livonian prosodic system? (2) What are the temporal patterns in Livonian words of more than two syllables? (3) Which acoustic features of Livonian *stød* are the most characteristic and how stable are they in connected speech?

The first research question arises from the somewhat unclear situation of Livonian disyllabic weak- and strong-grade words where a long first syllable is followed by either a half-long or a short syllable. It has been shown by Lehiste and co-authors (2008) that these words are similar to the Estonian long and overlong quantity words. However, the distinction between long and overlong feet is achieved by different means. The analysis of spontaneous Livonian attempts to explain the interaction between the pitch contours and different syllabic ratios. Additionally, the temporal and tonal characteristics of disyllabic weak-grade words with a short first syllable and a half-long second syllable are discussed in the thesis. Also, the question of the tonal uniformity is studied.

The second issue is motivated by the fact that the temporal structure of trisyllabic, tetrasyllabic and pentasyllabic words has not been thoroughly analyzed in previous research. One aim of the current thesis is to analyze different word structures with a focus on vowel and geminate durations in non-initial syllables and secondary-stressed feet.

The third research question emerges from the intriguing descriptions of Livonian tone opposition and the acoustic characterization of *stød*. In this thesis, words with and without *stød* are investigated in order to identify the main characteristic features of *stød* and to see how stable they are in connected speech. Previous studies have been based on read speech. For the current purposes both read and spontaneous speech is used. On the basis of previous research and the current acoustic data, a general description of Livonian *stød* is proposed.

1.2. Structure of the dissertation

The present doctoral thesis consists of an introductory part and six publications. The introductory part is divided into five chapters. Chapter 1 gives an introduction to the thesis, describes its structure, and provides a short overview of the publications. Chapter 2 describes the data and method used in the thesis. In Chapter 3 the general background of acoustic descriptions of word prosody is presented together with an overview of the previous studies of Livonian prosody. Chapter 4 sums up the results of the six publications. Chapter 5 provides the main conclusions of the thesis. The last chapter is followed by the references cited in the whole thesis and a summary in Estonian.

1.3. Overview of publications

The six publications are divided into three major topics. The first publication [P1] provides an overview of studies on the Livonian prosodic system. Three publications [P2, P3, and P4] deal with the temporal structure of Livonian words and the interaction between the durations and fundamental frequency. In two publications [P5, P6] the acoustic characteristics of Livonian stød are discussed.

[P1] gives an overview of earlier studies concerning Livonian prosody. In separate subsections a characterization of earlier treatments of Livonian quantity and tone system is provided. Also, the historical background of the Livonian language is presented.

[P2] focuses on the duration ratios and fundamental frequency in Livonian disyllabic words. The paper deals primarily with the role of quantity and tone, and their phonetic realization in spontaneous speech. The acoustic data was analyzed and discussed jointly by both authors of the paper. The final version of the paper was written by T. Tuisk.

[P3] describes the realization of the temporal and tonal characteristics of disyllabic words consisting of a short first syllable and a half-long second syllable in spontaneous speech. In addition, the pitch alignment in three different structures of disyllabic words is analyzed.

In [P4] the temporal structure of Livonian tri-, tetra- and pentasyllabic words is investigated. The main focus in the article is on non-initial syllables and secondary-stressed feet.

The aim of [P5] is to study the phonetic characteristics of Livonian stød. Both authors of the paper participated jointly in analyzing and discussing the acoustic data, as well as writing the final version of the paper.

[P6] is an extension of [P2] and [P5]. The paper focuses on the acoustic characteristics of words with and without stød consisting of a long first syllable and a short second syllable in spontaneous speech.

2. MATERIALS AND METHOD

2.1. Acoustic data

The acoustic data in articles [P2], [P3], [P4], [P5], and [P6] is taken from the Tartu University Archives of Estonian Dialects and Kindred Languages (<http://www.murre.ut.ee/arhiiv/>). The earliest recordings used are from the 1970s and the latest recordings were made in 2010. In the case of the recordings from the 1970s, 1980s and 1990s, digitalized tape recordings were used for the analysis. The author of this thesis participated in recording the Livonian speakers in 2004 and 2010, using high quality recording equipment (Sony Digital Audio Tape recorder and Edirol R-09HR). The material is from Courland Livonian spoken in Latvia. A total of 1123 words were analyzed.

Altogether the data from fifteen Livonian speakers (eleven female and four male) were analyzed. Eleven speakers are native speakers of Livonian and they all are from the eastern (villages Kūolka, Vaid, Sīkrōg, Kuoštrōg) and central (Īra village) parts of the Livonian Coast in Courland (Figure 1). The other four speakers learned Livonian from their parents or grandparents and speak it as a second language. Two of them were born in the eastern (Sīkrōg village) and western (Pizā village) parts of the Livonian Coast and two were born in Riga.

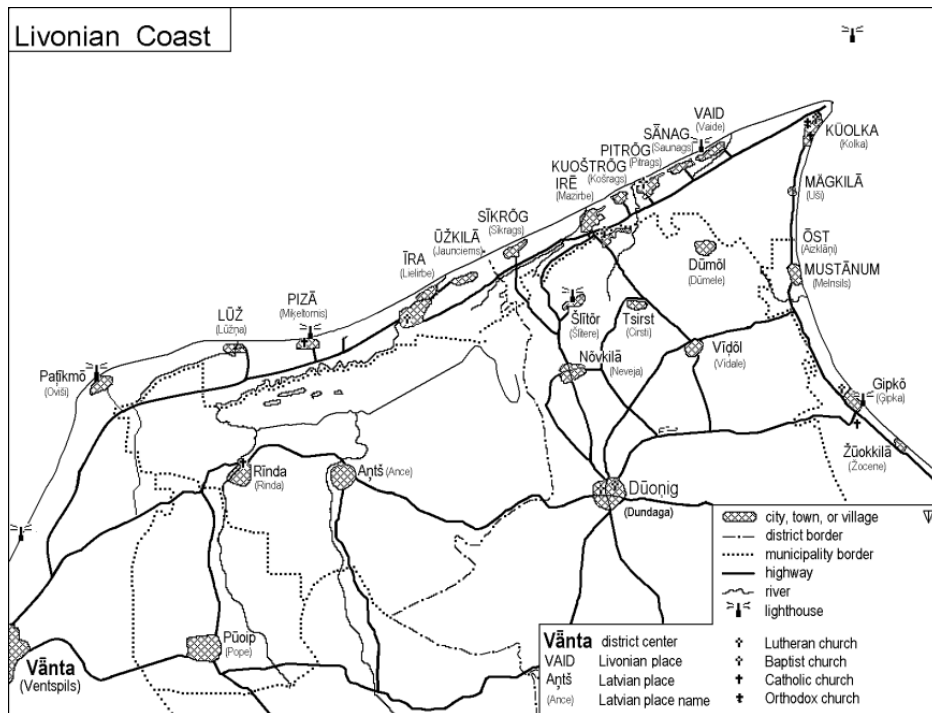


Figure 1. The Livonian Coast in Northern Courland in Latvia (map by Tiit-Rein Viitso).

In [P2] spontaneous speech of five female (born in 1880–1918) and three male native speakers (born 1904–1921) is analyzed. The speakers were recorded between 1972 and 1997. The speakers are from the villages in the eastern part of the Livonian Coast. The analyzed material consists of disyllabic weak-grade and strong-grade words with a long first syllable and a half-long or a short second syllable (e.g. *lēba* ‘bread’: *leibō* ‘bread, PSg’, *vī’mō*¹ ‘rain, PSg’).

[P3] investigated firstly the test words from the spontaneous speech of four native Livonian speakers (two female and two male), who were recorded in the 1970s. The female speakers were born in 1880 and 1889, and the male speakers in 1904 and 1909. The speakers are from the eastern part of the Livonian Coast. The analyzed material consists of disyllabic weak-grade words with a short first syllable and a half-long second syllable (e.g. *jemā* ‘mother’, *jumāl* ‘God’). Secondly, the material from [P2] was included as well as the comparative material presented by Lehiste et al. 2008.

In [P4] the majority of the material consists of words from read test sentences where the test words appeared in phrase-final and sentence-final position. Also, words from the word-triplets were analyzed and one example from spontaneous Livonian is discussed. The analyzed words are from eight Livonian speakers, who were recorded in 1976, 1997, and from 2000 to 2010. Four of them are older speakers, born between 1889 and 1921, who are native speakers of Livonian. Two are middle-aged speakers, born in 1950 and 1957. They heard Livonian from their parents and grandparents, but began to speak the language as adults. The two younger speakers were born in the 1970s. One of them acquired Livonian as a teenager and the other one during her childhood. The older and middle-aged speakers were born in the villages that belong to the eastern and western part of the Livonian Coast. The younger speakers were born in Riga.

In [P5] the acoustic material from two native female speakers (born in 1910 and 1918) from the Eastern Courland villages was analyzed. The recordings were made in the 1990s. The material consisted of minimal or near minimal pairs (monosyllabic and disyllabic strong-grade test words) from read speech, e.g. *ūdiz* ‘he/she cooked’: *ū’diz* ‘he/she drained’.

In [P6] the analyzed disyllabic vocalic strong-grade words (e.g. *mōdō* ‘land, PSg’: *mō’zō* ‘down’) are from six native Livonian speakers (three females and three males) who were recorded in the 1970s and 1980s. The speakers were born between 1889 and 1921, and come from the villages that belong to the eastern and central part of the Livonian Coast. The acoustic data is from spontaneous speech.

¹ Words with broken tone or stød are usually marked with an apostrophe in transcriptions.

2.2. Research method

The research method used in the current thesis is experimental acoustic-phonetic and involves acoustic analyses of the test words that occur in a certain position in the carrier sentence or phrase. Durations of all segments were measured and duration ratios of the syllable rhymes (or nuclei) in the foot were calculated. For fundamental frequency, the measurement points were taken at the beginning and end of each syllable, and at the peak or turning point of the F0 curve within the syllable. The methodology is the same used in the study on Livonian prosody (Lehiste et al. 2008). One of the reasons for choosing this method is the fact that the present thesis was started as part of the Finno-Ugric Prosody Project (for details see Lehiste & Pajusalu 2010), initiated by the late Ilse Lehiste. Unsolved questions that arose from Lehiste's study constitute the research basis for the thesis.

The recordings were analyzed using Praat software for speech analysis (Boersma & Weenink 2008–2015). The acoustic data were extracted from the manually annotated TextGrids using Praat scripts. The location of the F0 peak or turning point relative to the beginning of the first syllable (S1) or second syllable (S2) was manually annotated (the turning point is the point where there is a noticeable change in the direction of the F0 contour from rising or level to falling). All questionable measurements were manually checked.

For the current thesis, material was collected from both read speech and spontaneous speech. Some acoustic features are more clearly realized in read speech, but the main issue here is to what extent the acoustic features described in controlled speech are found in spontaneous non-controlled situations.

In article [P2], data from spontaneous speech containing words in sentence-initial and sentence-medial position were analyzed. Articles [P3], [P6] and a small part of [P4] use words from spontaneous speech, where words in phrase-internal position were investigated, i.e. the test words were not preceded or followed by a pause. This position could be considered somewhat neutral and the words in this position formed the most complete set of data. All test words in articles [P2], [P3], [P4] and [P6] were in a stressed position. The material in paper [P5] and most of the material in [P4] come from controlled speech, i.e. the test words were read in frame sentences.

In [P3] a correlation test was carried out with the statistics package R (R Development Core Team, version 2.14.0). In [P5] the intensity turning point was manually determined. The mean intensity was calculated for both voiced syllable rhymes in [P6]. The statistical analysis of the whole data was carried out using the statistical package R (R Development Core Team, <http://www.r-project.org>) and Microsoft Excel.

3. BACKGROUND AND EARLIER RESEARCH

3.1. Acoustic study of word prosody

In this subchapter a brief overview of the terminology used in the thesis is given with reference to studies on word prosody in Estonian, Finnish, Latvian, Lithuanian and Danish. This work is relevant to the acoustic study of Livonian because Livonian shares similar prosodic characteristics with these languages.

Prosody deals with such elements of speech that are properties of larger speech units than segments, i.e. syllables, words, phrases etc. Prosodic features above the level of phoneme or segment are called suprasegmental (Lehiste 1970). The study of word prosody involves such aspects as quantity, foot isochrony, tone differentiation and word stress, but also weakening of the secondary-stressed feet and vowel reduction in unstressed syllables.

3.1.1. Stress

Stress can be described as a conventional label for the overall prominence of certain syllables relative to others within a linguistic system (e.g. Lehiste 1970; Clark & Yallop 1995). Word stress does not have just one acoustic correlate but it represents the total effect of factors such as pitch, loudness and duration. Where words have their own stress pattern, the stress is usually called word stress or lexical stress (or even word accent).

Within a word-level unit the position of stress is usually fixed and may function as a boundary signal. For instance, in verse or song, the wording is characteristically organized to yield a regular rhythm, and the units of this rhythm are commonly called feet (e.g. Ross & Lehiste 2001). Each foot, whether a single syllable or several syllables, tends to take the same amount of time. This tendency towards foot isochrony or equal timing is characteristic of, for instance, Finnic languages.

3.1.2. Duration and pitch

In speech production, duration is a property of sounds or units related to the larger context of time and timing. The duration of segments and syllables is influenced by many contextual factors, i.e. the manner of articulation, suprasegmental factors (especially by the placement of prominence or stress), but also the position of the segment or syllable within a word (e.g. Lehiste 1970; Clark & Yallop 1995).

The term *tone* is used to refer to the contrastive function of fundamental frequency at the word level, while the term *intonation* refers to the linguistically significant functioning at the sentence level (e.g. Lehiste 1970). Duration often interacts with pitch, which is the perceived correlate of fundamental frequency.

A complex phenomenon involving both durational and tonal characteristics is the quantity system in Estonian (e.g. recent studies by Lippus et al. 2013; Prillop 2013; Pajusalu 2014). Estonian is one of the languages that differentiates between three degrees of length, usually referred to as short (Quantity 1), long (Quantity 2) and overlong (Quantity 3). In the Estonian quantity system, pitch is additionally employed in order to distinguish between Q2 and Q3. Thus, among other languages where three-way oppositions are reported (Remijsen & Gilley 2008), Estonian is one of the few that differentiates between more than two degrees of length.

Estonian quantities are shown as ratios of the duration of stressed and unstressed syllables of a foot with pitch as an additional characteristic feature (e.g. Lehiste 1960; Liiv 1961). Perception studies have shown that pitch is a vital cue for distinguishing between the long and overlong quantity degrees (e.g. Lehiste 1975; Lehiste & Danforth 1977; Eek 1980a, 1980b). Research on Estonian spontaneous speech has demonstrated that quantity-related pitch variation can be influenced by intonation and the long vs. overlong quantity opposition can only be based on temporal cues (e.g. Krull 1993a, 1993b; Traunmüller & Krull 2003). The typical S1/S2 ratio is 0.7 in a Q1 foot, 1.5 in a Q2 foot and 2.0 in a Q3 foot (Lehiste 1960). Similar results have been reported by others as well (e.g. Liiv 1961; Krull 1991, 1992; Eek & Meister 1997). Somewhat larger syllable duration ratios have been reported in spontaneous speech – for example 0.8 in Q1 feet, 1.8/2.3 in Q2 feet, 2.6/3.4 in Q3 feet (e.g. Lippus et al. 2013). Studies on Estonian quantity perception and acoustics have shown the importance of pitch in Estonian word prosody. Pitch as a decisive factor between Q2 and Q3 can be observed not only in laboratory speech but also in connected speech (Lippus 2011).

Finnish has been shown to be a typical quantity language where F0 does not play any role on the lexical level (Suomi et al. 2008). Nevertheless, it has been indicated that a longer quantity involves an earlier F0 fall (Vainio et al. 2010), and the perception of tone and quantity are closely related (Järvikivi et al. 2010). Suomi (2005a, 2005b, 2007) has suggested that the motivation for certain durational changes in the word is the fact that they help to achieve tonal uniformity. The interaction between durational changes and tonal characteristics of the accent is signalled by the similar realization 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 (e.g. Suomi 2005b).

3.1.3. Broken tone or stød

Similar phenomena as the broken tone or stød found in Livonian have been described in other neighbouring languages such as Latvian, Lithuanian and Danish. Syllable intonations or tones are part of the prosodic system of Latvian (e.g. Kariņš 1996; Markus 1991; Dogil 1999; Markus & Bond 2010). The

difference between intonations² finds its realization in all long syllables. Latvian is known as a language with three syllable intonations – falling, level or drawling, and broken. However, there is a great variation in Latvian dialects with a tendency to replace the broken intonation with falling intonation and to combine the falling and the drawling intonations into a single level intonation. It has been concluded that the use of Latvian syllable intonation is not important in communication (e.g. Markus & Bond 2010) and such ternary oppositions are realized only in few word triplets.

Lithuanian is a language with two contrastive tones: the sharp falling or acute tone and the smooth rising or circumflex tone (e.g. Balode & Holvoet 2001). The distinction between tones is clearest in the western part of Lithuania, especially in Northern Žemaitian dialects, where the main acute tone is realized by the broken (glottalized) tone. The broken tone has been described as having an initial rise of pitch and intensity, after which a glottal stop intervenes and the remaining part of the vocalic segment is much lower in intensity and pitch (e.g. Zinkevičius 1994; Balode & Holvoet 2001).

The basic acoustic and perceptual properties of Danish stød are well documented (e.g. Grønnum & Basbøll 2007, Grønnum et al. 2013). In Danish, stød has traditionally been characterized as a kind of creaky voice, i.e. non-modal voice with aperiodic and irregular amplitude, often accompanied by a fundamental frequency perturbation, and an abrupt and brief dip in fundamental frequency (e.g. Fischer-Jørgensen 1989). Danish stød has also been explained by phonation type as a brief dynamic voice quality movement in the direction of more compressed voice and back, rather than involving a specific voice quality such as creak (Hansen 2015).

3.2. Previous studies on Livonian prosody

A survey of previous studies of the Livonian prosodic system reveals a certain degree of agreement among researchers. The first scientific descriptions of the Livonian prosodic system are from the 19th century. The special status of Livonian tones was first noticed by the Estonian linguist Ferdinand Johann Wiedemann (1861) and the Danish linguist Vilhelm Thomsen (1890). However, Wiedemann explained the existence of different tones as specific vowel or consonant lengths similar to quantity contrasts in Estonian. Thomsen described Livonian stød as similar to that of Danish.

The experimental research on Livonian was initiated mainly by the interest in the broken tone. The first acoustic-phonetic studies on Livonian word prosody were carried out in the phonetics laboratory of the University of Tartu in the 1920s by the Finnish linguist Lauri Kettunen (1925) and his student Paulopriit Voolaine (1922).

The data used for the research on Livonian prosody has usually come from controlled or read speech, i.e. single test words or frame sentences. Until 2008,

² Latvian phonetic tradition generally uses the term *intonation*.

experimental studies were based on the data collected from one speaker (except Suhonen 1982), whereas afterwards most studies have used materials from more than one speaker.

3.2.1. Quantity in Livonian

An opposition between short and long phonemes is always observed in the Livonian quantity system. This opposition of short and long durations is evident in stressed syllables. Livonian also differentiates between single consonants, short geminates, and long geminates, but this three-way opposition is manifested only on the boundary of a stressed and unstressed syllable. Both vowel length and consonantal length alternations are distinguished. It was observed already at the beginning of the 20th century that the half-length of Livonian unstressed syllables is related to the duration of the stressed syllable (Voolaine 1922; Kettunen 1925). When the first stressed syllable of a word is short, the second syllable vowel is half-long (see also Posti 1936; Pajupuu & Viitso 1986; Lehiste et al. 2008). A half-long vowel can also occur in secondary-stressed syllables (Posti 1936; Lehiste et al. 2008). In the case of a long first syllable, the second unstressed syllable is either short (Kettunen 1925; Lehiste et al. 2008) or half-long (Lehiste et al. 2008).

Questions of Livonian phonology have been thoroughly studied by Tiit-Rein Viitso (1981, 2007b, 2008), who has established the main types of tone and quantity patterns. He has discussed prosodic alternations in Livonian words using the complex concept of word accent, which combines stress, tone, and quantity.

Descriptions of Livonian monophthongs, diphthongs and triphthongs (e.g. Pajupuu & Viitso 1986) show that they take part in the quantity and quality paradigmatic alternation (see an example of Livonian polyphthongs in Table 1).

Table 1. Livonian diphthongs and triphthongs.

Short first component			Long first component	
Short final component	Long final component	Broken tone	Plain tone	Broken tone
<i>aigā</i> 'edge, NSg'	<i>aigō</i> 'time, PSg'	<i>a'igō</i> 'edge, PSg'	<i>āiga</i> 'time, NSg'	<i>lō'igi</i> 'asunder'
<i>kuoigīd</i> 'ships'	<i>luoimō</i> 'warp, PSg'	<i>kuo'igō</i> 'ship, PSg'	<i>lūoima</i> 'warp, NSg'	<i>tū'oigōz</i> 'birch bark'

Tiit-Rein Viitso's phonological analysis (e.g. Viitso 1981, 2008) divides Livonian diphthongs into rising (closing) and falling (opening) diphthongs according to their quality. Rising diphthongs are long and can be divided into those with a long initial component (e.g. *āi* as in *pāika* 'place, NSg') and those

with a short initial component (e.g. *ei* as in *leibõ* ‘bread, PSg’). Falling diphthongs are either short (*ie* and *uo*, e.g. *piezā* ‘nest, NSg’, *suodā* ‘war, NSg’) or long (*īe* and *ūo*, e.g. *sīedõ* ‘eat, Inf’, *kūona* ‘frog, NSg’). The total duration of short diphthongs equals the duration of short monophthongs (phonetic measurements by Lehiste et al. 2008 have shown that short monophthongs can also be a little longer). Livonian triphthongs developed through diphthongization of the initial components of the diphthongs beginning with *-e* and *-o*, and partly as a result of the loss of *h* and metathesis (Viitso 1981).

A comparison of words with and without *stød* by Seppo Suhonen (1982) showed that in disyllabic words with a closed first syllable the short vowel is longer in words with *stød*, while in mono- and trisyllabic words the vowel is shorter. Regarding long monophthongs and diphthongs, the vowels in disyllabic words with *stød* are shorter than the vowels without *stød*.

Hille Pajupuu and Tiit-Rein Viitso’s study (1986) on Livonian polyphthongs revealed that there is an inverse relationship between vowels of the first and the second syllable: a half-long or long vowel in the unstressed syllable appears only in words with a short polyphthong in the preceding syllable. The temporal ratios of the two syllables of the metric foot have been in focus only in recent years (Lehiste et al. 2007, 2008). The question of the foot reveals that like in Estonian, Livonian too has a ternary opposition, but it is achieved by somewhat different means (for details see 4.1.1.). A similar ternary contrast of consonant duration in Estonian, Ingrian, Inari Saami and Livonian has been shown (Markus et al. 2013; Türk et al. 2014).

3.2.2. Tone in Livonian

The question of tonal oppositions has been a much debated issue in the research on Livonian prosody. In primary-stressed syllables two tones occur: the plain (or rising) tone, and the broken tone, which is rising-falling or predominantly falling and is sometimes accompanied by laryngealization (e.g. Viitso 2007b). The main focus of the discussion has been on broken tone or *stød* (usually marked with an apostrophe in transcriptions), which has equivalents also in Salaca Livonian (Winkler 2000, 2010) and in South Estonian dialects in Latvia (Teras 2010). An intriguing aspect has been the question of the segmental nature of *stød*, while the prosodic function has received less attention. Another debate has been on the question of syllable nuclei that do not carry the broken tone, i.e. syllables with the plain tone. There are attempts to analyze the Livonian situation by referring to units larger than the segment carrying the broken tone, for example the complex notion of word accent, which combines stress, tone, and quantity (Viitso 1981). The concept of syllable weight has been treated as well (Kiparsky 2006).

One complicated aspect of descriptions of the broken tone or *stød* in Livonian is the use of different terms. This is most likely due to the different interpretation of the phenomenon as well as the use of the language to describe

it, and the tradition of the particular research group. Thus, in referring to tone or intonation, English *broken tone*, *glottalized tone*, *broken intonation*, German *Stosston*, *Bruchintonation*, *gestossene Intonation*, Danish *stød*, Finnish *katkointonaatio*, Estonian *katketoone* etc. are used. For segmental characteristics, English *glottal stop*, German *der Bruch der Stimme*, *Stimmbruch*, *Stosslaut* or *Bruchlaut*, Danish *stød*, Finnish *katko*, French *coup de glotte*, Estonian *katkehäälilik* etc. are used. English *laryngealization*, *glottalization* or *creaky voice* have been used is in use to describe irregular vibrations of the vocal folds. The question of terminology becomes more confusing when a particular term covers all acoustic features, which in order to simplify the understanding of the description should be treated separately. Despite the question of terminology, there always seems to be an agreement regarding the opposition of the presence and absence of this phenomenon.

Lauri Kettunen (1925) described the Livonian *stød* as the breaking of the voice (*Stimmbruch*) in the middle or the end of the sound. He did not propose any specific term for the plain tone. In the 1930s he had an exciting discussion on the topic with his student Lauri Posti, who was critical of Kettunen's explanations. Namely, Posti (1936) found it odd that the so-called breaking of the voice, which is such an important factor in Livonian, can often be completely absent. Posti himself was the one who distinguished three intonations in Livonian, i.e. rising, broken and falling³. Later he added short intonation to this list (Posti 1937a). However, in the study with Aarni Penttilä (1941) he discusses only the opposition of rising and broken intonation (see Figure 2).

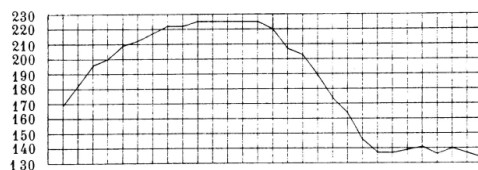


Abb. 1. *kõmal*.

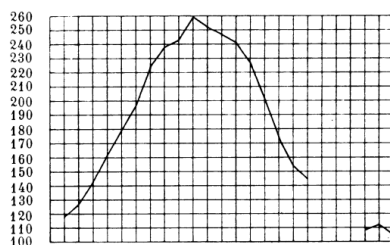


Abb. 22. *rõgõd*.

Figure 2. Examples of words *kõmal* ‘handful’ with rising intonation and *rõgõd* ‘harness, NPI’ with broken intonation (Penttilä, Posti 1941: 253, 259).

³ Posti used the terms traditionally used for Latvian tones.

Marilyn May Vihman (1971) has noted that the most characteristic acoustic features of Livonian stød are (1) a relatively early fundamental frequency (F0) fall, (2) variation in intensity, and (3) irregular vibrations of the vocal folds. She pointed out that the absolute correlation between level intonation and the absence of stød would appear to confirm the suggestion that the overall pitch contour functions as part of the perceptual cue for stød in Livonian. Livonian stød becomes more apparent from the intensity contour as well as the pitch contour. Vihman's results were somewhat supported by the analysis of Pajupuu and Viitso (1986), showing a sharp F0 rise (often also with a sharp fall) and a decrease in intensity in words with stød.

Ilse Lehiste et al. (2008) have found differences across generations of Livonian speakers, concluding that the phonological opposition between the presence and absence of stød has almost disappeared from the language. The acoustic features characteristic of the broken tone were evident in the pronunciation of the older generation, while the middle and youngest generation differed among themselves and sometimes the characteristic features were absent entirely.

There have been discussions on the origin of Livonian stød. The most general question is whether Livonian stød is a Latvian influence (as suggested for instance by Winkler 1999, 2000 and Kiparsky 2006) or if it has arisen independently in Livonian and Latvian, with apocope, syncope and syllable contraction being the main reasons for its development in Livonian (as proposed, for instance, by Posti 1942).

4. RESULTS AND DISCUSSION

4.1. Temporal and tonal characteristics of Livonian words

In this chapter the research results of the publications [P2], [P3], [P4], [P5], and [P6] are discussed together with the background references. The description of the main characteristics of Livonian word prosody is followed by the analysis of durational and tonal patterns in different word structures, and the acoustic characteristics of Livonian stød.

4.1.1. Main characteristics of Livonian word prosody

Livonian has preserved the main prosodic features characteristic of Finnic languages, such as (a) word-initial stress and (b) the phonological opposition of short and long phoneme duration. Particular characteristics of Livonian are (a) the opposition of the plain tone and broken tone (i.e. stød), (b) the differentiation of short and long diphthongs and triphthongs, and (c) a wide difference in the structure of stressed and unstressed syllables. A distinctive feature of Livonian as compared to other Finno-Ugric languages is the gemination of voiced plosives and fricatives.

Gradation in Livonian is a regular alternation of the strong-grade (SG) and weak-grade (WG) stressed syllables and unstressed syllables (thoroughly described and explained by Viitso 2007b). Three structural types of Livonian gradation can be established (Viitso 2007b: 49–50). Firstly, weak-grade stems where the post-tonic syllable contains an intervocalic resonant or a lenis obstruent followed by a long vowel alternate with strong-grade stems with the broken tone, cf. *kalād* [kalàɖ] ‘fish, NPI’ and *ka’llõ* [ka’llõ] ‘fish, PSg’, *tiegūd* [tiegũɖ] ‘face, NPI’ and *tie’ggõ* [tie’ggõ] ‘face, PSg’. Secondly, weak-grade stems with an intervocalic fortis obstruent or a cluster beginning with a fortis obstruent followed by a long vowel alternate with strong-grade stems with the plain tone, cf. *kikīd* [kikkid] ‘rooster, NPI’ and *kikkõ* [kikkõ] ‘rooster, PSg’. Thirdly, weak-grade stems where the first syllable contains a long nuclear vowel and the post-tonic syllable a short vowel alternate with strong-grade stems with the plain tone and a heavy coda consisting of a vowel or a resonant consonant in the stressed syllable, cf. *lūoikõd* [lũoikõɖ] ‘hollow; valley, NPI’ and *luoikõ* [luoikkõ] ‘hollow; valley, PSg’, *kūondad* [kũoñɖɖ] ‘heel, NPI’ and *kuondõ* [kuoñɖ] ‘heel, PSg’.

One of the features characterizing the quantity opposition in Livonian is the duration ratio of syllables in a foot (e.g. Lehiste et al. 2008; Pajusalu 2014). It has been shown that vowel durations in stressed and unstressed syllables are involved in establishing three contrastive foot types in Livonian that resemble the three-way contrastive feet of Estonian (Lehiste et al. 2008). However, the three-way contrasts between foot types are manifested phonetically in different ways. For example, Livonian vocalic words with a short first syllable have a half-long second syllable vowel (which phonetically is rather a long vowel).

The V1/V2 ratio (0.5–0.7) is comparable to that found in Estonian Q1 words. Unlike in Estonian, Livonian can have a short diphthong in the first syllable, which can be longer than a short vowel. Still, there is a half-long vowel in the second syllable as well, and the V1/V2 ratio is a little bigger. Results on a long first syllable with a half-long and a short second syllable vowel have revealed that the corresponding V1/V2 ratios (1.8 and 2.4) resemble those of Estonian Q2 and Q3 words. Unlike in Estonian in Livonian, the long vowel and diphthong in the first syllable are closer in duration, and the difference in the second vowel duration is somewhat greater. In Estonian, there is a systematic difference in the first vowel duration and unstressed second syllable vowel.

There is a ternary contrast of consonants in Livonian as well (e.g. Kettunen 1925; Lehiste et al. 2008). Livonian can have a single consonant, a short geminate, and a long geminate in intervocalic position between stressed and unstressed second syllable (e.g. *kadāg* ‘juniper’, *katāb* ‘he/she covers’, *kattō* ‘to cover’). Both the short geminate and the long geminate close the preceding syllable. After a long geminate the second syllable vowel is significantly shorter than after a short geminate. In Livonian consonant clusters, there is a similar correlation between the duration of the consonant cluster and the following syllable as in Estonian. For example, in the word *mustā* ‘black’ there is a short consonant cluster followed by a half-long vowel, while in the word *mustō* ‘black, PSg’ there is a long consonant cluster followed by a short vowel.

Livonian broken tone or *stød* requires a certain minimum amount of voiced material in the syllable rhyme in order to be realized. The so-called *stød-basis* is a long stressed syllable with a long vowel, diphthong, triphthong, or a short vowel followed by a voiced geminate consonant or consonant cluster (e.g. *rō’dō* ‘money, PSg’, *kuo’igō* ‘ship, PSg’, *ka’ddō* ‘to disappear’, *ka’lḏi* ‘fish, PPl’). This phenomenon must not be ignored, as *stød* has a phonological role in differentiating meaning (e.g. *kallō* ‘island, PSg’, *ka’llō* ‘fish, PSg’). Livonian *stød* is to a large extent predictable from syllabic and morphological structure. Hence, it would be appropriate here to explain the use of the term ‘words where *stød* is expected’ in articles [P2] and [P5]. This is due to the differentiation of words where the acoustic features of *stød* are actually realized or not realized (similarly to Lehiste et al. 2008). Also, laryngealization is sometimes referred to as being *stød*. In [P4] and [P6] simply ‘words with and without *stød*’ are indicated.

4.1.2. Duration and pitch in disyllabic primary-stressed feet

Articles [P2] and [P3] discuss the role of quantity and fundamental frequency in disyllabic weak-grade and strong-grade words in spontaneous Livonian. In both articles, the main issue is the interaction between syllabic ratios and pitch contours associated with particular word structures. In order to see whether the ternary opposition indicated by Lehiste et al. (2008) is realized also in spontaneous speech, three word structures were analyzed.

In [P2] Livonian weak-grade (WG) and strong-grade (SG) words with a long first syllable consisting of voiced sounds were analyzed, e.g. *rānda* (WG) ‘shore’: *randõ* (SG) ‘shore, PSg’. The prosodic structure of such words resembles in some respect that of Estonian disyllabic Q2 and Q3 words, i.e. words of long and overlong quantity (that is the reason for using *Q2 words* and *Q3 words* in [P2], although they can be referred to as *WG* and *SG words* as well). The main conclusion of [P2] is that there are differences in the realization of these two word structures (see Table 2).

Table 2. Average syllable durations (ms), duration ratios and foot durations (ms) in WG and SG words without stød (N = number of tokens, WG = weak-grade words, SG = strong-grade words).

Group	WG, words without stød					SG, words without stød				
	N	S1	S2	S1/S2	foot	N	S1	S2	S1/S2	foot
1	74	203	97	2.22	348	79	211	77	2.84	344
2	36	238	88	2.73	363	37	205	72	2.85	322

The speakers constituted two groups according to the duration ratios of the syllables. One group of speakers (Group 1) did differentiate these words, while the other group (Group 2) did not. In the first group, the duration of the first stressed syllable did not differ significantly in WG and SG words, but the difference is evident in the second syllable duration. In the pronunciation of the second group, the S2 duration was also shorter in SG than in WG words, but SG words had even shorter S1 duration than WG words. Thus, the ternary opposition indicated by Lehiste et al. (2008) might not always be realized. Differences between speakers’ pronunciation can be explained by their background (i.e. geographical as well as family background) and by the essence of spontaneous speech.

SG words with stød had shorter first syllable duration than SG words without stød, but the second syllable duration was almost the same. This result is in line with previous studies, which have showed the same tendency (Suhonen 1982; Lehiste et al. 2008).

There is a tendency towards foot isochrony in Livonian (Lehiste et al. 2008). Like in Estonian, the duration of the first syllable – which carries the stress – increases, while the duration of the unstressed second syllable decreases (e.g. Ross & Lehiste 2001; Lehiste 2003; Nolan & Asu 2009), and vice versa, in order to achieve approximately equal duration of the foot. Figure 3 illustrates the relationships between the two syllables in disyllabic feet containing a long first syllable followed by a half-long or short second syllable.

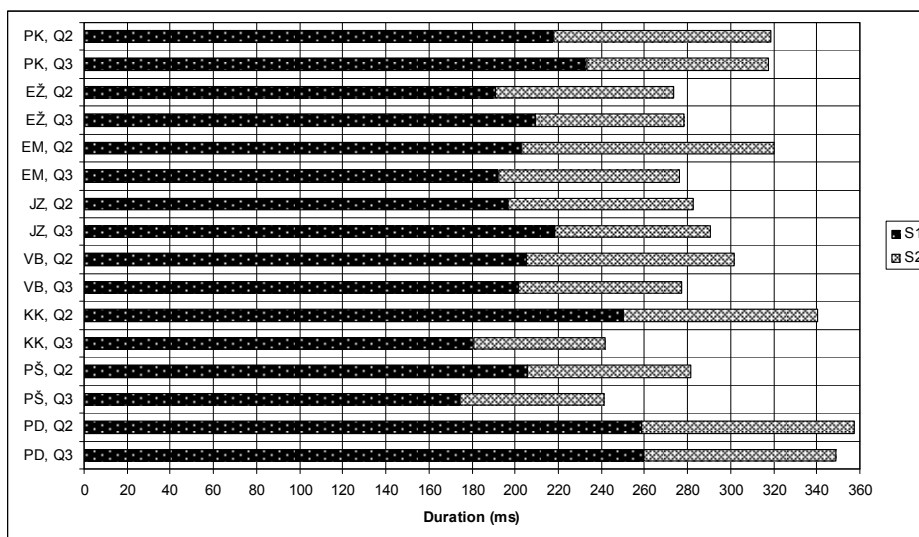


Figure 3. Mean S1 and S2 durations in WG (Q2) and SG (Q3) words without *stød* of eight Livonian speakers.

The analysis of [P2] reveals that the pronunciation of some speakers exhibits a trend of foot isochrony: when the first syllable duration increases the second syllable duration decreases. In the pronunciation of other speakers, WG and SG words had an almost equal duration of S1, but the S2 was considerably longer in WG than in SG words. Also, some speakers have a longer S1 duration in WG words than in SG words.

It has been indicated by Lehiste et al. 2008 that sentence intonation plays a prominent role in determining the fundamental frequency movement – the same word could have a rising F0 in phrase-final position and a falling F0 in sentence-final position. Nevertheless, on the level of word prosody the difference between a rising and falling F0 contour turned out to be crucial in words with a long first syllable and either a half-long or short second syllable. Namely, words with a half-long second syllable had a rising F0 contour (late F0 peak) on the first syllable, while words with a short second syllable had a falling F0 contour (an early F0 peak) on the first syllable. It was concluded that the F0 contours resemble those found in Estonian Q2 and Q3 words. Characteristically in Estonian, in Q2 words the F0 peak is located at the end of the stressed syllable and pitch falls in the unstressed syllable. In Q3, the pitch begins to fall in the first half of the stressed syllable and the fall continues in the unstressed syllable.

The results of [P2] do not fully support this conclusion. The tonal analysis revealed that WG words without *stød* had a late F0 peak or the peak occurred during the onset of the second syllable or even at the beginning of the second syllable vowel. However, in SG words without *stød*, the peak was also late in most cases, but sometimes occurred earlier as well. Such variation could be

explained either by the essence of spontaneous speech or the influence of utterance-level intonation. Thus in Livonian, pitch alignment is not such a decisive factor for differentiating WG and SG words as in Estonian, where pitch is an additional very characteristic feature in differentiating the quantity degrees.

In Livonian, the tonal patterns are more distinct in the opposition between words with and without *stød*. SG words with *stød* are characterized above all by an early F0 peak. Even under the influence of utterance-level intonation, the words with *stød* had a different F0 peak location than words without *stød*. Laryngealization occurred rarely in the materials from spontaneous speech in [P2]. Even if the laryngealization was absent in words with *stød*, the F0 peak was earlier in the first stressed syllable.

The analysis of Livonian disyllabic WG words with a short first syllable and a half-long second syllable (CV.CV̇ structure, e.g. *jemā* ‘mother’) in [P3] indicate that the temporal characteristics in these words are rather similar both in read speech and spontaneous speech. The data from spontaneous speech and read speech are presented in Table 3.

Table 3. Vowel durations (in ms) and duration ratios in CV.CV̇ words from spontaneous speech and read speech (N = number of tokens).

	N	V1	V2	V1/V2	Foot
Spontaneous speech	60	87	164	0.54	312
Read speech	38	103	211	0.5	401

Vowel durations in this word structure in spontaneous speech were shorter than in read speech, but the syllable ratios in the foot were the same. The prosodic structure of such Livonian words resembles that of Estonian disyllabic Q1 words (words of short quantity). Still, there is a difference as compared to the results from spontaneous speech in Estonian (Asu et al. 2009; Lippus et al. 2013). Namely, the second syllable duration in spontaneous Livonian is twice as long as in spontaneous Estonian.

Earlier results using read sentences have shown that the F0 turning point is towards the end of the first stressed syllable in phrase-final position or at the beginning of the syllable in sentence-final position (Lehiste et al. 2008). However, in spontaneous speech it appeared intriguingly that the F0 turning point was at the beginning of the second syllable (see Figure 4).

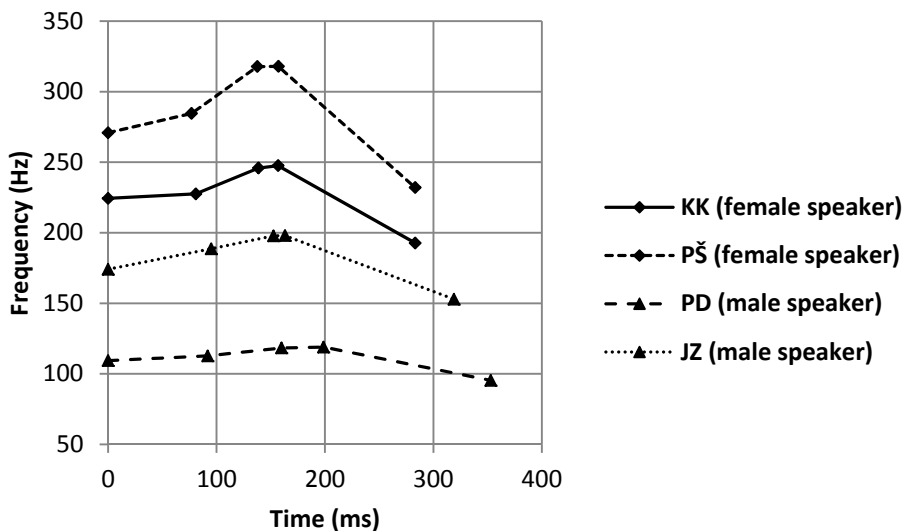


Figure 4. Pitch contours of the CV.CV̇ word structure in spontaneous speech. The five measurement points are taken (1) at the beginning of V1, (2) at the end of V1, (3) at the beginning of V2, (4) at the turning point, and (5) at the end of V2.

Similar tendency has been found for spontaneous Estonian (Lippus et al. 2013). A correlation test showed that there is a correlation between the duration of the second syllable and the F0 turning point location, which suggests that a longer V2 duration is closely related to a late F0 turning point.

The overall contours of the fundamental frequency of the three Livonian disyllabic word structures only somewhat support Kari Suomi's (2005a, 2005b, 2007) idea of tonal uniformity, according to which there is only one F0 tune irrespective of word structure. With some exceptions (for example, the weak-grade words with a short first syllable and a half-long second syllable, e.g. *jemā*), the overall tonal contour in Livonian was rising-falling in most cases, despite the durational differences in the syllables. Figures 5 and 6 present the pitch contours of the three word structures.

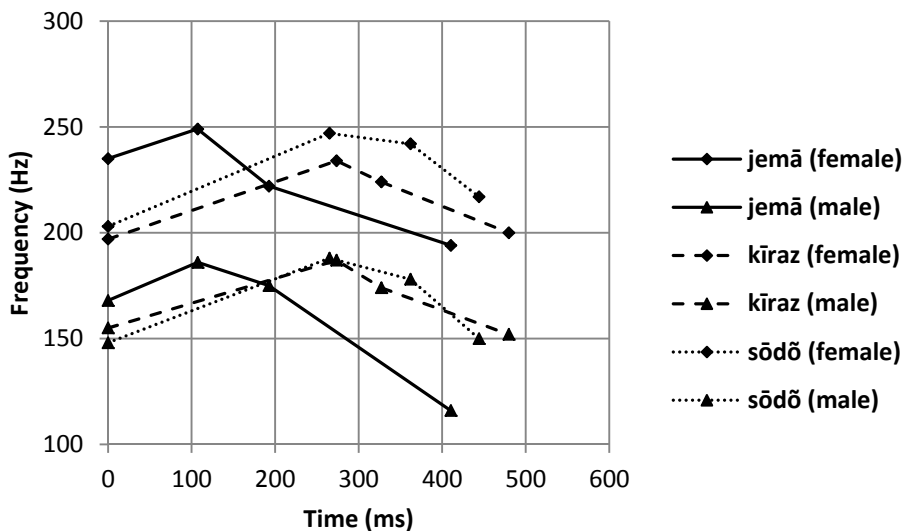


Figure 5. Pitch contours of the three word structures of disyllabic words without *stød* in read sentences (both female and male speakers). The four measurement points are taken (1) at the beginning of V1, (2) at the end of V1, (3) at the beginning of V2, and (4) at the end of V2.

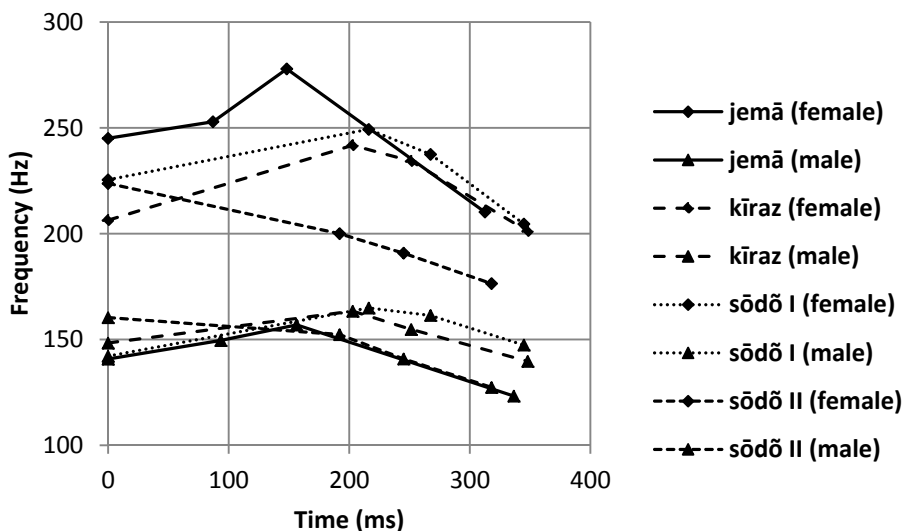


Figure 6. Pitch contours of the three word structures of disyllabic words without *stød* in spontaneous speech (female and male speakers). The four measurement points are taken (1) at the beginning of V1, (2) at the end of V1, (3) at the beginning of V2, and (4) at the end of V2.

Also, the overall pitch alignment is an indication of foot isochrony. The inverse duration of the first and second syllable refers to the tendency to achieve equal durations of the foot and is supported by the general pitch contours as well as the F0 measurement point at the end of the second syllable vowel.

4.1.3. Temporal structure of tri-, tetra- and pentasyllabic words

Paper [P4] analyzed Livonian trisyllabic, tetrasyllabic and pentasyllabic words with various structures with the focus on non-initial syllables and secondary-stressed feet. The primary stress in Livonian is on the first syllable of a word and the secondary stress is usually on the third syllable of a word. However, in the derivational affix *-nikā* the secondary stress can be on the second syllable of a word.

The results of tetrasyllabic words are in line with the findings of Lehiste et al. (2008), showing that the syllable durations and duration ratio of secondary-stressed feet is similar to that of primary-stressed feet in Livonian. The lengthening of the unstressed syllable is significantly greater in a primary-stressed foot than in a secondary-stressed foot. A similar pattern is found by Pajusalu et al. (2005) in the case of Saaremaa variety (in the western periphery of Estonia). 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*.

The analysis of trisyllabic words revealed one particular pattern in words with a long initial syllable followed by a short second and third syllable vowel. Namely, the S2 vowel was always shorter in duration than the S3 vowel. Thus 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 distinction of short and long geminate consonants is characteristic of Livonian. After a short geminate, the vowel duration is always half-long (or even long), while after a long geminate the vowel duration is significantly shorter. The analysis of [P4] confirms that this pattern appears in words of more than two syllables as well. The short geminate duration is similar in both disyllabic and longer words. However, long geminates are significantly longer in duration in disyllabic words than in trisyllabic and tetrasyllabic words. Still, the long geminates in tri- and tetrasyllabic words are approximately 1.5 times longer than short geminates.

The derivational affix *-nikā* tends to operate as an independent word and generally behaves in the same way in trisyllabic, tetrasyllabic and pentasyllabic words. The second vowel after the short geminate in the affix *-nikā* was usually as long as in disyllabic words indicated by Lehiste et al. (2008). The syllable ratios in the affix were the biggest in trisyllabic words, which may be explained by the shorter half-long vowel duration than that of tetra- and pentasyllabic

words. In the partitive case (*-nikkõ*) the syllable durations were greater in tetra-syllabic words.

4.2. Acoustic features of stød

Articles [P5] and [P6] focus more thoroughly on the acoustic characteristics of Livonian stød. The following questions are discussed in the articles: (1) What are the main phonetic characteristics that differentiate words with stød from words without stød? (2) How stable are the main phonetic characteristics of stød in spontaneous speech? (3) What is the role of intensity in characterizing Livonian stød? [P5] uses data from read speech, while [P6] presents data from conversational speech.

4.2.1. Temporal characteristics

Previous research has shown that long stressed syllables are generally shorter in duration in words with stød than in words without stød (e.g. Suhonen 1982). The analysis of read speech in [P5] confirmed that in monosyllabic words the syllable nucleus is significantly shorter in words with stød than in words without stød. The same pattern appeared in disyllabic words with stød with an open first syllable. In the case of a closed first syllable, the differences between syllable durations in words with and without stød are smaller. [P6] shows that in spontaneous speech, the first syllable duration in disyllabic words with and without stød might also get neutralized.

A comparison of the second syllable (S2) duration in disyllabic words revealed that in read speech the S2 durations are the same in words with and without stød, but in spontaneous speech there is a significant decrease of the S2 duration in words with stød.

The results of [P5] and [P6] suggest that laryngealization (an example in Figure 7) is realized more often in read speech than in spontaneous speech. This is not surprising considering that in controlled speech the test words are pronounced with greater concentration. In spontaneous speech, this characteristic feature tends to weaken or disappear. The occurrence of a complete glottal closure in words with stød (as found for example by Kettunen (1925) and Vihman (1971)) was not detected in the data analyzed for [P5] and [P6].

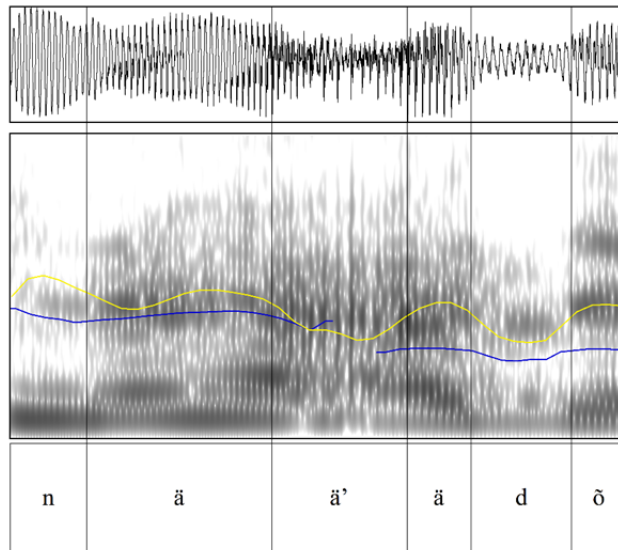


Figure 7. Waveform (upper part) and spectrogram (lower part) example of the word with stød *nã'dõ* ‘to see’ from spontaneous speech pronounced by a female speaker (blue line = fundamental frequency, yellow line = intensity). Laryngealization period is marked with *ä* and apostrophe.

In read speech, the beginning of laryngealization was approximately at the 25–30 % mark of the stressed syllable. The duration of laryngealization varied, being on average 74–95 ms. In spontaneous speech, the location of laryngealization also varied, but was most often located in the middle of the syllable rhyme. The duration of the laryngealization varied more in spontaneous speech, ranging from 19 to 179 ms. The duration of the S1 rhyme in the words with stød was significantly greater when laryngealization was present.

4.2.2. Tonal characteristics

Various researchers have pointed to the influence of sentence intonation, which can take precedence over word prosody (e.g. Penttilä & Posti 1941; Vihman 1971; Lehiste et al. 2008), revealing that the tone contours might be relatively difficult to determine. The analysis of [P5] and [P6] showed that the most stable and characteristic feature of words with stød appears to be an early location of the F0 peak or turning point within the stressed syllable and the characteristic shape of the pitch contour (as indicated for example by Penttilä & Posti 1941; Pajupuu & Viitso 1986). Although occasionally there was an influence of the sentence intonation, the predominant feature of an early F0 peak was evident most of the time (the characteristic patterns of pitch alignment from spontaneous speech are presented in Figure 8). When there was no clear occurrence of laryngealization, the pitch contour was still characteristic (Figure 9).

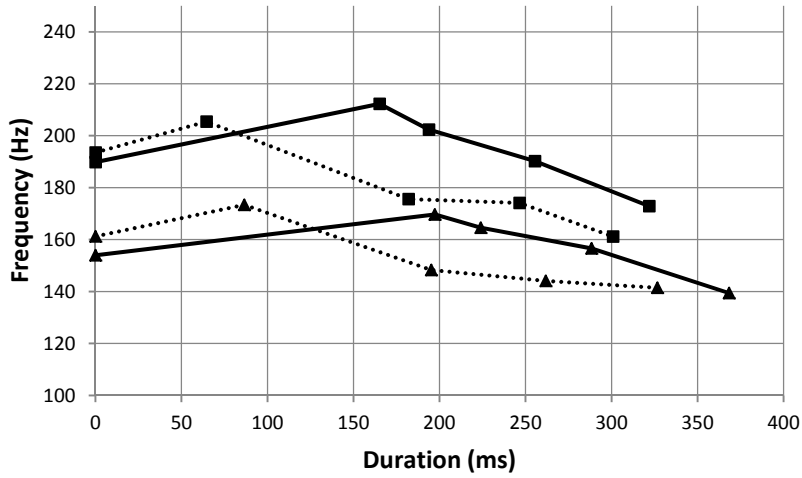


Figure 8. Fundamental frequency (in Hz) in words with stød (dashed line) and without stød (solid line) for three female speakers (black squares) and three male speakers (black triangles). The five points are at the S1 rhyme beginning, F0 peak, S1 rhyme end, S2 rhyme end.

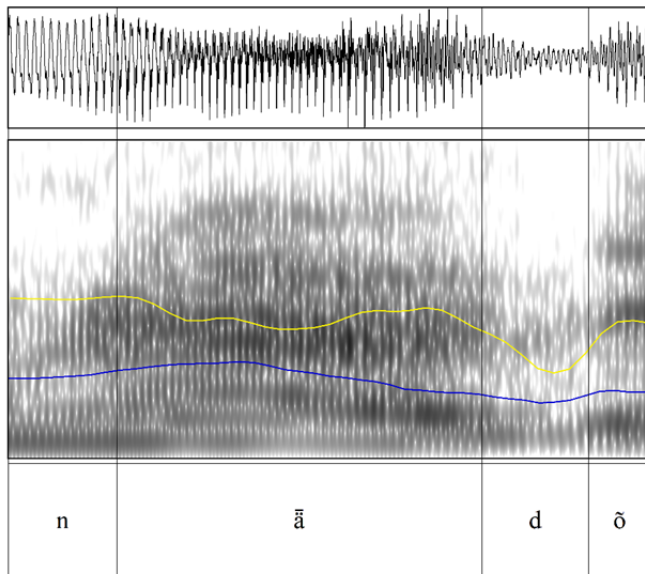


Figure 9. Waveform (upper part) and spectrogram (lower part) example of the word with stød *nā'dō* 'to see' from spontaneous speech pronounced by a female speaker (blue line = fundamental frequency, yellow line = intensity).

Because of an early F0 turning point there is a noticeable F0 fall from the turning point to the end of the syllable. The F0 values in the beginning of the first syllable in words with *stød* were slightly higher than in words without *stød*.

There is also a characteristic feature of both syllables of disyllabic words. The F0 values in S1 were usually bigger in words with *stød* than in words without *stød*, but in S2 the F0 values were considerably smaller in words with *stød*.

4.2.3. Role of intensity

The question of intensity was treated with caution, as intensity is delicate in many aspects, including segment quality, recording quality etc. Pajupuu and Viitso (1986) have shown that sometimes there is a decrease or drop in intensity in words with *stød*. According to Vihman (1971), the intensity curve of the words with *stød* is more varied and less stable. Papers [P5] and [P6] concluded that as regards intensity, the most characteristic feature in words with *stød* appears to be the irregular intensity contour within the S1 rhyme, while in words without *stød* the intensity alignment is more stable (see an example from spontaneous speech in Figure 10).

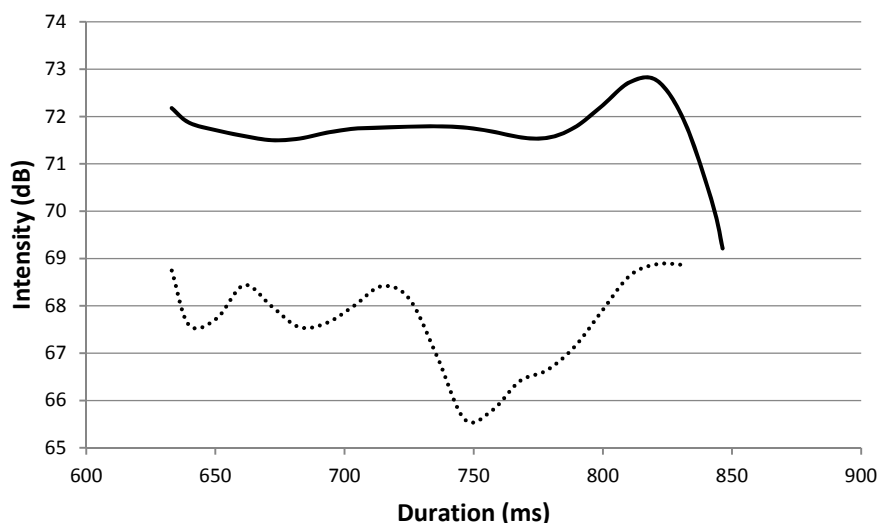


Figure 10. Intensity contours (in dB) in S1 in the word *mōdō* ‘land, PSg’ (solid line) and in the word *mō'zō* ‘down, Adv’ (dashed line) from one female speaker.

In the case of laryngealization there was always an irregular movement of the intensity contour. More specifically, there was a sudden dip or drop in intensity. In [P5] the location of the intensity turning point was established and, in

general, the location of the intensity turning point appeared to be characteristic in describing words with *stød*. Although the location of the intensity turning point sometimes varied, its location was generally similar to the F0 turning point, being mostly in the first half of the stressed syllable.

It has been shown that the intensity of the first syllable vowel in words with *stød* is greater than in those without *stød*, whereas in the second syllable vowel the intensity is weaker in words with *stød* than those without *stød* (Vihman 1971). The results of [P6] did not support this tendency, revealing that there is no significant difference in average S1 intensity values between words with and without *stød*, but the difference is evident in the S2 values: in words with *stød* the S2 intensity was smaller than in words without *stød*. Thus, the differences in average intensity values become evident only in the interaction between both syllables of a word.

On the basis of previous studies on Livonian *stød*, Kalevi Wiik (1989) has concluded that it is considerably harder to find *stød* (in Finnish he calls it *katko*) in continuous speech than in words produced in controlled speech. The analysis of [P5] and [P6] agrees with his conclusions in the sense that the acoustic features are realized more clearly in read speech than in spontaneous speech. As to descriptions from other languages, Livonian *stød* shares similar characteristics with *stød* in Latvian, Lithuanian and Danish.

Laryngealization has also received a great deal of attention. It has been described as a certain phonation pattern, i.e. irregular vibration of the vocal folds (e.g. Vihman 1971). However, sometimes the terms laryngealization and *stød* are treated as synonyms (e.g. Lehiste et al. 2008). On the basis of acoustic evidence, various discussions on this topic and as a conclusion of [P5] and [P6], it can be said that in Livonian, laryngealization itself is not *stød* but rather is one characteristic feature of words with *stød*.

For the confusing matter of terminology and definition of words with *stød*, the following solution is suggested. There is an opposition of words with a broken and plain tone or words with and without *stød* in Livonian. Livonian *stød* can be defined as a phonological unit, which on the suprasegmental level has particular characteristic features. In terms of acoustics, it is reasonably easy to characterize *stød* by means of the fundamental frequency, intensity and durational patterns. The most typical characteristic is a specific F0 shape, which can be accompanied by laryngealization and irregular intensity in the stressed syllable. It is suggested that the acoustic characteristics of not only the first syllable but also the second syllable should receive greater attention in describing words with and without *stød*.

5. CONCLUSIONS

The current thesis examined different aspects of Livonian word prosody. The central issues were the role of quantity and fundamental frequency in the Livonian prosodic system and the main acoustic features of Livonian *stød*.

Syllable durations in stressed and unstressed syllables are commonly involved in establishing three contrastive foot types in Livonian that resemble the three-way contrastive feet of Estonian. However, such a ternary opposition is not always realized in Livonian. Livonian disyllabic weak-grade words with a short first syllable and a half-long second syllable are similar to Estonian Q1 words, but the duration of the half-long second syllable vowel in Livonian is longer than in Estonian. The temporal characteristics of these Livonian words are rather similar both in read speech and spontaneous speech. The prosodic structure of Livonian weak-grade and strong-grade words with a long first syllable consisting of voiced sounds resembles that of Estonian disyllabic Q2 and Q3 words, but there are differences in realizing these two word structures. The duration of the first stressed syllable might not differ in weak- and strong-grade words, but the difference becomes evident in the second unstressed syllable duration. The tendency towards foot isochrony in Livonian indicated on the basis of data from controlled speech is supported by the data from spontaneous speech.

The structures of primary-stressed and secondary-stressed feet are in principle alike. The syllable durations and duration ratios of secondary-stressed feet in tetrasyllabic words are similar to those of primary-stressed feet in Livonian, but the lengthening of the unstressed syllable is significantly bigger in a primary-stressed foot than in a secondary-stressed foot. The syllable ratios in trisyllabic secondary-stressed foot are similar to the ratios in primary-stressed foot if the secondary-stressed foot contains the derivational affix *-nikā*.

In Livonian disyllabic weak-grade words with a short first syllable followed by a half-long second syllable the F0 turning point is at the beginning of the second syllable and there is a correlation between the duration of the unstressed syllable and the F0 turning point location (longer unstressed syllable duration is closely related to a late F0 turning point). There is no reason to apply characteristic tonal patterns of words characteristic to those of Estonian Q2 and Q3 words to Livonian, as these patterns are not as clear in Livonian. Words without *stød* can have a late pitch peak in weak-grade words, while in strong-grade words the F0 peak can vary in the first stressed syllable. Thus, while pitch is a decisive factor between Q2 and Q3 in Estonian, it is not that important in Livonian. In Livonian, the tonal characteristic is more evident in the opposition of words with and without *stød*. In terms of pitch, strong-grade words with *stød* are characterized above all by an early pitch peak. Even when the peak occurs later in the first syllable, it is still earlier than the late peak in strong-grade words without *stød*.

The question of acoustic features of Livonian *stød* is unquestionably intriguing. The characteristic patterns may be more evident in read speech than

in spontaneous speech, but some features are still stable in spontaneous speech as well. The results of this thesis suggest that not only the syllable carrying stød but also the following syllable might cue the difference between words with and without stød. In spontaneous speech, the first syllable durations in disyllabic words with and without stød might get neutralized. In read speech the durations of the second syllable are the same in words with and without stød, but in spontaneous speech there is a significant decrease of the second syllable duration in words with stød. The most stable and characteristic feature of words with stød is an early location of the F0 turning point and intensity turning point within the stressed syllable and the characteristic shape of the pitch contour as well as the intensity contour. Characteristic laryngealization is realized more often in read speech than in spontaneous speech. In spontaneous speech, this characteristic feature tends to weaken or disappear. However, even if the laryngealization is absent in words with stød, the pitch peak is earlier in the stressed syllable.

The study of Livonian word prosody is undoubtedly a challenge for any researcher interested in this southern Finnic language. The wide number of possible sound patterns, syllable and foot structures, and the tone differentiation as well as the historical background of the language can be frightening. Nevertheless, the Livonian prosodic system is definitely one of the most unique in the contact area of the Baltic Sea.

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SUMMARY IN ESTONIAN

Liivi sõnaprosoodia

Käesolev doktoriväitekirj käsitleb kestust ja põhitooni liivi sõnaprosoodias. Töös analüüsitakse rõhuliste ja rõhutute silbistruktuuride ning põhitooni omavahelist seost kindla kõnetaktistruktuuriga sõnades.

Väitekirja koosneb sissejuhatavast peatükist ja kuuest publikatsioonist. Sissejuhatavas peatükis antakse ülevaade uurimisvaldkonnast, tutvustatakse töö materjali ja töös kasutatavat uurimismeetodit ning võetakse artiklite uurimistulemused ühtse käsitlusena kokku. Väitekirjas esitatud kuus publikatsiooni jagunevad kolme põhiteema vahel. Esimeses artiklis antakse ülevaade liivi prosoodia varasematest käsitlustest ja uurimistulemustest. Järgnevad kolm artiklit keskenduvad erineva struktuuriga kõnetaktidele liivi keeles. Kahes viimases artiklis vaadeldakse põhjalikumalt liivi katketooni akustilisi tunnuseid.

Väitekirja kolm peamist uurimisküsimust on: 1) milline on liivi keele kahe-silbiliste nõrga- ja tugevaastmelise struktuuriga sõnade rõhuliste ja rõhutute silpide kestuste, kestussuhete ja põhitooni omavaheline seos kõnetaktis; 2) milline on liivi pikemate kui kahe-silbiliste sõnade struktuur; 3) millised akustilised tunnused iseloomustavad liivi katketooni ja kui püsivad need kõnes on.

Esimene uurimisküsimus on tingitud mõnevõrra ebaselgest olukorrast liivi lühikese ja pika esisilbiga kahe-silbiliste püsi- ja katketooniga sõnade nõrga- ja tugevaastmelistes vormides. Liivi kahe-silbiliste sõnastruktuuride analüüs (Lehiste jt 2008) on näidanud, et eesti keelele iseloomulik rõhulise silbi lühikese, pika ja ülipika vokaaliga sõnade ternaarne vastandus esineb liivi keeles üsna piiratult. Liivi keele puhul on määrav pigem rõhulise ja rõhutu silbi suhe. Selgus, et eesti teise ja kolmanda välte eristamiseks iseloomulik põhitooni kontuur on ilmne ka liivi keeles. Väitekirjas püütakse spontaankõne materjali abil täpsemalt selgitada nõrga- ja tugevaastmeliste sõnastruktuuride tempo-raalseid ja tonaalseid tunnuseid.

Liivi keele pikemaid sõnu on seni uuritud üsna põgusalt. Väitekirjas antakse ülevaade kolme-, nelja- ja viiesilbiliste sõnade struktuuridest ja keskendutakse eeskätt järgsilpide vokaalide ja geminaatide kestustele ning kastrõhulisele kõnetaktile.

Väitekirja kolmanda uurimisküsimuse puhul kirjeldatakse põhjalikumalt liivi toonisüsteemi ja eeskätt katketoonile iseloomulikke akustilisi tunnuseid. Loetud kõnest ja spontaankõnest pärit ainekuga näidatakse, millised on liivi katketooni (ehk *stød*'i) kõige iseloomulikumad tunnused ja kui stabiilsed need tunnused kõnes on.

Materjal ja meetodika

Publikatsioonides [P2], [P3], [P4], [P5] ja [P6] analüüsitud materjal on pärit Tartu Ülikooli eesti murrete ja sugulaskeelte arhiivist (<http://www.murre.ut.ee/>)

arhiiv/). Helisalvestised on pärit vahemikust 1976–2010. Väitekirja autor käis liivi keelejuhtide kõnet salvestamas 2004. ja 2010. aastal.

Väitekirjas kasutatud uurimisainestik on pärit viieteistkümnelt liivi keelejuhilt (üheteistkümnelt naiskeelejuhilt ja neljalt meeskeelejuhilt). Üksteist keelejuhti on emakeelsed liivlased ja nelja puhul oli liivi keel nende vanemate ja vanavanemate keel. Kõik emakeelsed liivlased on pärit Kuramaa liivi ranna küladest. Neljast nooremast kaks on sündinud liivi külades ja kaks Riias. Nii loetud kui ka spontaanselt kõnest kogutud andmed sisaldavad ühtekokku 1123 sõna mõõtmistulemusi.

Töö on oma olemuselt eksperimentaalfoneetiline uurimus. Väitekirja uurimismeetod põhineb keeleteadlase Ilse Lehiste algatatud soome-ugri keelte prosodia uurimise projektis kasutatud meetodil (vt Lehiste, Pajusalu 2010). Käesolev töö on välja kasvanud projekti liivi prosodia uurimusest „Livonian prosody“ (2008) ning tundus loogiline jätkata sama meetodiga, mis tähendab konkreetse materjali foneetilisi mõõtmisi ja andmete akustilist analüüsi. Uurimuses esile kerkinud küsimused moodustasid põhja käesolevaks tööks.

Uurimismaterjali märgendamiseks ja analüüsimiseks kasutati kõneanalüüsi-programmi Praat (Boersma, Weenink 2008–2015). Akustilise analüüsi tulemuste statistiliseks töötluseks kasutati programmi R (<http://www.r-project.org>) ja Microsoft Excelit.

Analüüsi jaoks märgendati kõikide testsõnade segmentide kestused, arutati silpide kestused ja nende omavahelised suhted kõnetaktis. Põhitooni väärtused mõõdeti sõna esimese ja teise silbi algus- ja lõpp-punktides. Põhitooni tipu väärtus mõõdeti käsitsi punktist, kus põhitooni kontuuri muutus oli kõige selgemalt jälgitav (ehk põhitooni kontuur hakkas langema). Samuti määrati põhitooni tipu või pöördepunkti kaugus silbi algusest. Intensiivsuse analüüsiks mõõdeti artiklis [P5] intensiivsuse väärtused kõikide silpide algus- ja lõpp-punktides. Intensiivsuskontuuri tipp ja selle kaugus silbi algusest määrati sarnaselt põhitooni kontuuriga. Analüüsi jaoks artiklis [P6] mõõdeti keskmine intensiivsus nii sõna esimeses kui ka teises silbis.

Uurimisküsimused

Artiklis [P2] otsitakse vastuseid kolmele küsimusele: 1) millised on kestus-suhted pika rõhulise esisilbiga kahesilbilistes nõrga- ja tugevaastmelistes takti-struktuurides spontaanses kõnes; 2) kas põhitooni kontuur varieerub erinevate silbisuhete puhul; 3) kas põhitooni tipu asukoht erineb püsi- ja katketooniga sõnades.

Artiklis [P3] vaadeldakse, kas 1) liivi lühikese rõhulise esisilbiga ja poolpika rõhutu silbiga nõrgaastmelised kahesilbilised sõnad käituvad sarnaselt nii loetud kui ka spontaanses kõnes; 2) kas rõhutu silbi kestus ja põhitooni tipu asukoht selles sõnastruktuuris korreleeruvad; 3) kas liivi sõnaprosodia tasandil eksisteerib erinevate struktuuriga sõnades ühesugune põhitooni kontuur.

Pikemate kui kahesilbiliste sõnade struktuure uuritakse artiklis [P4]. Vaadeldakse: 1) millised on pikemates sõnastruktuurides segmentide ja silpide kestused ning silpide omavahelised kestussuhted; 2) kas liivi kaasrõhulise takti struktuur erineb oluliselt pearõhulise takti struktuurist.

Artiklid [P5] ja [P6] otsivad vastuseid küsimustele: 1) millised peamised akustilised tunnused eristavad püsi- ja katketooniga sõnu ja kui stabiilsed need tunnused on spontaanses kõnes; 2) milline on intensiivsuse roll püsi- ja katketooniga sõnades.

Ülevaade liivi prosoodia uurimustest

Liivi keele teaduslik uurimine algas 19. sajandi teisel poolel, mil keeleuurimisreise liivlaste aladele alustasid Peterburi Teaduste Akadeemia akadeemikud Anders Johan Sjögren ja Ferdinand Johann Wiedemann. Wiedemann (1861) märkas arvatavasti esimesena erinevaid toone liivi sõnades, kuid selgitas tonaalsust hoopis vokaalide ja konsonantide erinevast pikkusest lähtuvalt. Ta kirjeldab liivi vokaalide ja konsonantide kvantiteedisuhteid võrdluses eesti keele pika ja ülipika kvantiteediga. Mõned aastakümned hiljem kirjeldas liivi katketooni taani keeleteadlane Vilhelm Thomsen (1890) oma doktoriväitekirjas. Tema kõrvu jäi taani keelele omane *stød* ühe liivi meremehe kõnes, keda Thomsen küsitles oma doktoriväitekirja jaoks hoopis seoses germaani laensõnadega.

Liivi keele eksperimentaalse uurimise algatajaks võib pidada soome keeleteadlast Lauri Kettuneni, kelle akustilifoneetiline uurimus keskendus just liivi keele katketoonile (Kettunen 1925). Tegelikult eelnes sellele uurimusele Kettuneni juhendatud üliõpilase Paulopriit Voolaine auhinnatud töö liivi keele kvantiteedist 1922. aastal, kuid see käsikirjaline uurimus paraku nii laialdast tähelepanu pole pälvinud (Voolaine 1922). Kuni 2008. aastani põhinesid pea kõik liivi keele foneetilised uurimused ühelt kõnelejalt pärit materjalil (erandiks on siiski 1982. a Seppo Suhoneni töö). Suurem osa uurimistulemustest põhineb loetud raamlausetega kõnel. Spontaanset liivi keelt on rohkem uuritud just viimasel aastakümnel.

Liivi fonoloogia olemust on põhjalikult selgitanud Tiit-Rein Viitso (nt Viitso 1981, 2007b, 2008). Muuhulgas selgitab ta liivi astmevahelduse süsteemi. Nimelt iseloomustab liivi kahesilbilist jalastruktuuri nõrga- ja tugevaastmeliste rõhusilpide vaheldumine rõhutute silpidega (nt *kalād* [kalàð] 'kalad, NPI' ja *ka'llō* [ka'llō] 'kala, PSg', *tiegūd* [tiegūd] 'näod, NPI' ja *tie'ggō* [tie'ggō] 'nägu, PSg', *kikīd* [kikīd] 'kuked, NPI' ja *kikkō* [kikkō] 'kukke, PSg', *lūoikōd* [lūoikōd] 'orud, NPI' ja *luoikō* [luoikkō] 'orgu, PSg'). Liivi sõna pearõhulise silbi ehitus on suhteliselt keeruline diftongide ja triftongide tõttu, mille osised võivad osaleda kvantiteedivastandustes (vt tabelit nr 1, pt 3.2.1.).

Enamasti on liivi kvantiteedisüsteemi puhul alati täheldatud lühikeste ja pikkade häälikute vastandumist. Keeles vastanduvad lühikesed konsonandid ning lühikesed ja pikad geminaadid (nt Kettunen 1925; Posti 1942; Markus jt

2013). Pearõhulise lühikese silbi seost järgneva rõhutu silbi poolpikkusega on näidatud mitmetes töedes (Voolaine 1922; Kettunen 1925; Pajupuu, Viitso 1986). Poolpikkust on täheldatud ka kaasrõhulises kõnetaktis (Posti 1936; Lehiste jt 2008). Eesti keeles täheldatud taktiisokrooniad (Lehiste 2003) esineb ka liivi keeles: esimese ja teise silbi vahel on pöördvõrdeline seos.

Palju arutelusid on olnud liivi toonisüsteemi ja eriti katketooni ümber (Kettunen 1936, 1937; Posti 1936, 1937a, 1937b). Nimelt evivad liivi pikad rõhusilbid kas tõusvat püsitooni või tõusev-langevat katketooni (Viitso 2008). Viimast iseloomustab mõnikord larüngalisatsiooni olemasolu. Katketoon (mida liivi keele foneetilises transkriptsioonis tähistatakse enamasti apostroofiga) saab esineda ainult pikas ja helilises silbis (nt *rõ'dõ* 'raha, PSg', *vie'ddõ* 'vedada', *ku'llõ* 'kuluda', *sa'ddõ* 'sadada', *su'žzi* 'hunte, PPI'). Püsitoon esineb nii lühikestes kui ka pikkades rõhusilpides.

Raskesti jälgitavad on katketooni kirjeldused juhtudel, kus uurijad kirjeldavad nähtust eri terminitega. Sageli on küsimus nähtuse segmentaalses olemuses või tooni ja intonatsiooni olemuses. Lauri Kettunen (1925, 1937, 1938, 1960) räägib hääle murdumisest ehk katkest ja katketoonist (*der bruch der stimme* või *stimmbruch*, *stosston*, vt nt Kettunen 1925: 4), Lauri Posti (1936, 1937a, 1937b) katkest ja katkeintonatsioonist (*katko*, *katkointonaatio*). Fanny de Sivers (1965) on veendunud, et tegemist on puhtalt segmentaalse üksusega (*the glottal stop*) ja mitte tooniga. Marilyn May Vihman (1971) kasutab taanikeelset terminit *stød*, Seppo Suhonen (1982) saksakeelset *der Stoss*, Hille Pajupuu ja Tiit-Rein Viitso (1986) taanikeelset *stød*, Kalevi Wiik (1989) soomekeelset *katko*. Üksmeelsed ollakse aga selle nähtuse esinemises või mitteesinemises.

Liivi toonide analooge teistes läänemeresoome keeltes ei leidu, küll aga võib võrreldavaid toone leida balti keeltest (Kariņš 1996; Balode, Holvoet 2001; Markus, Bond 2010). Ühiseid katketooni akustilisi kirjeldusi jagab liivi keel taani keelega (Vihman 1971; Fischer-Jørgensen 1989; Grønnum jt. 2013; Hansen 2015).

Väitekirja uurimistulemused

Artiklis [P2] käsitletakse liivi pika esisilbiga nõrgaastmelisi (nt *lēba* 'leib', *rānda* 'rand') ja tugevaastmelisi (nt *leibõ* 'leiba, PSg', *randõ* 'randa, PSg', *vī'mõ* 'vihma, PSg') kahesilbilisi sõnu. Lehiste jt (2008) on näidanud, et liivi kahesilbiliste sõnade temporaalsed ja tonaalsed tunnused sarnanevad eesti teise- ja kolmandavälgeliste sõnadega. Artikli [P2] uurimistulemused sellist väidet täielikult ei toeta. Liivi püsitooniga nõrga- ja tugevaastmeliste sõnade esimeses rõhulises silbis olulist kestuserinevust ei olnud (mida on näidanud ka Lehiste jt 2008). Erinevus kahe sõnastruktuuri vahel ilmnis rõhutu silbi kestuse erinevuses ja sellest tulenevalt rõhulise ja rõhutu silbi kestussuhetes. Selgus aga, et see eristus ei esine siiski kõigi keelejuhtide kõnes ning kõnelejad võis jagada kaks rühma (vt tabelit 2, pt 4.1.2.). Ühe rühma kõnelejade häälduses oli rõhulise

esisilbi kestus nii nõrga- kui tugevaastmelistes sõnades ühesugune, kuid rõhutu silbi kestus oli märkimisväärselt lühem tugevaastmelistes sõnades. Teise rühma kõnelejate häälduses oli rõhutu silbi kestus tugevaastmelistes sõnades samuti lühem kui nõrgaastmelistes sõnades, kui nõrgaastmeliste sõnade rõhulise silbi kestus oli pikema kestusega kui tugevaastmeliste sõnade rõhulise silbi kestus. Sellist erinevust pika esisilbiga nõrga- ja tugevaastmeliste sõnade osas võib antud juhul põhjendada keelejuhtide taustaga (geograafilise ja perekondliku taustaga). Samas tugevaastmeliste katketooniga sõnade esimese rõhulise silbi kestus oli alati lühem kui püsitooniga tugevaastmeliste sõnade esisilbi kestus.

Põhitooni analüüs artiklis [P2] näitab, et eesti keele teise- ja kolmevälteliste sõnade iseloomulikku põhitooni kontuuri pole tegelikult mõtet liivi keelest otsida. Liivi nõrgaastmeliste sõnade põhitoon oli küll alati tõusev, kuid tugevaastmeliste sõnade puhul põhitooni kontuur varieerus. Põhitooni tipp nendes sõnades võis olla nii pearõhulise esisilbi alguses kui ka lõpus. Küll aga ilmneb selge erisuse tendents püsitooniga ja katketooniga sõnade vahel. Nimelt oli katketooniga sõnades põhitooni tipp alati varasem kui püsitooniga sõnades. Nii et eesti keele teise- ja kolmevälteliste sõnade iseloomulik põhitooni kontuur liivi keelele päris iseloomulik pole.

Liivi lühikese esisilbiga ja poolpika teise silbiga nõrgaastmelistes sõnades (nt *jemā* 'ema') on teise silbi vokaal märgatavalt pikem kui eesti keeles (vt [P3]). Põhitooni analüüs loetud kõne puhul on näidanud, et põhitooni tipp sellise struktuuriga sõnades on kas rõhulise silbi alguses või lõpus (Lehiste jt 2008). Spontaanse kõne tulemused näitavad aga, et põhitooni tipp sellistes sõnades on rõhutu silbi alguses (vt joonist 4, pt 4.1.2.) ning põhitooni tipu asukoht on seotud rõhutu silbi vokaali kestusega – mida pikem on rõhutu silbi vokaal, seda hilisem on põhitooni tipp taktis. Kari Suomi (2005a, 2005b, 2007) on soome keele näitel välja pakkunud seisukoha, et erinevates sõnastruktuurides võib eksisteerida üldine n-ö tonaalne ühtsus (ingl *tonal uniformity*), mis tähendab, et erineva struktuuriga sõnadel võib olla ühesugune põhitooni kontuur. Kui mõned erandid (eeskätt lühikese esisilbiga ja poolpika teise silbiga nõrgaastmelised sõnad) välja jätta, siis liivi keele kahesilbilised sõnastruktuurid võiksid seda väidet toetada (vt jooniseid 5 ja 6, pt 4.1.2). Kahesilbiliste sõnade puhul ilmneb ühesugune põhitooni tõusev-langev liikumine. Taktiisokrooniale ehk kõnetaktide samapikkusele viitab seejuures eriti selgelt põhitooni languse lõpp-punkt, mis on erinevate sõnastruktuuride puhul samas kohas.

Liivi prosodia varasemates uurimustes pole kahesilbilistest sõnadest pikemaid sõnu eriti uuritud. Käesoleva töö raames on artiklis [P4] võetud vaatluse alla kolme-, nelja- ja viiesilbilised sõnad. Kolmesilbiliste sõnade puhul ilmnes oluline joon sõnades, kus pikale esimesele rõhusilbile järgnevad kaks lühikese vokaaliga rõhutut silpi. Nimelt on kolmanda silbi vokaal nendes sõnades alati pikem teise silbi vokaalist. Neljasilbiliste sõnastruktuuride analüüs näitas, et silpide suhted kaarõhulises kõnetaktis on enamasti sarnased rõhulise ja rõhuta silbi suhtega pearõhulises taktis. Viiesilbilistes sõnades sarnaneb kolmesilbiline kaarõhuline takt pearõhulise kolmesilbilise taktiga ainult juhul, kui kaarõhulises taktis esineb tuletusafiks *-nikā*. See afiks käitub oma

olemuselt nagu omaette sõna. Liivi keele lühikesed ja pikad geminaadid eristuvad selgelt ka kahesilbilistest sõnadest pikemates sõnades. Pika geminaadi kestus kolme- ja neljasilbilistes sõnades on umbes poolteist korda pikem lühikese geminaadi kestusest.

Artiklid [P5] ja [P6] uurivad põhjalikumalt liivi katketooni (mille analooge võib leida läti, leedu ja taani keelest) akustilisi omadusi. Artiklis [P5] on uurimismaterjaliks loetud minimaalpaarid, kus üks testsõna on püsitooniga ja teine katketooniga. Andmed loetud kõnest kinnitasid enamasti varasemaid katketooni kirjeldusi (nt Vihman 1971; Suhonen 1982), et pearõhuliste silpide kestused katketooniga sõnades lühenevad. Artikli tulemused näitavad, et silbid võivad lüheneda eeskätt ühesilbilistes sõnades ja lahtise esisilbiga kahesilbilistes sõnades. Kinnise pearõhulise silbiga sõnades ei pruugi püsi- ja katketooni puhul kestuserinevusi olla. Rõhutu silbi puhul mingeid kestuserinevusi ei täheldatud. Oluline erinevus püsi- ja katketooni sõnade vahel on põhitooni tipu asukoht, mis püsitooniga sõnades on pearõhulise silbi lõpus ja katketooniga sõnades pearõhulise silbi alguses või vähemalt esimeses pooles (iseloomulikule toonikontuurile katketooniga sõnades on viidanud ka valdav osa varasematest uurimustest, nt Posti 1937a, b; Penttilä, Posti 1941; Vihman 1971; Pajupuu, Viitso 1986). Sarnane tendents ilmnes ka intensiivsuskontuuri tipu asukoha puhul. Katketooniga sõnadele iseloomulik larüngalisatsioon esines loetud kõnes märkimisväärselt sageli.

Artikli [P6] jaoks koguti andmeid spontaanselt ehk loomulikult kõnest, et näha, kui stabiilsed liivi katketooni akustilised tunnused kõnes on. Selgus, et temporaalsed tunnused võivad spontaankõnes ühtlustuda. Pearõhulises silbis seni näidatud kestuserinevusi püsi- ja katketooniga kahesilbiliste sõnade puhul välja ei tulnud. Oluline erinevus ilmnes aga rõhutu silbi kestuses, mis oli katketooniga sõnades lühem kui püsitooniga sõnades. Vaatamata teatavale lauseintonatsiooni mõjule, eristusid katketooniga põhitooni kontuurid selgesti püsitooniga sõnadest. Põhitooni tipp katketooniga sõnades oli varasem kui püsitooniga sõnades. Intensiivsuse analüüs näitas, et äärmiselt iseloomulik on ebaregulaarne intensiivsuskontuur katketooniga sõnade pearõhulises silbis. Oletus, et pearõhulise silbi intensiivsuse keskmised väärtused erinevad püsi- ja katketooniga sõnades, ei leidnud kinnitust. Erinevus ilmnes siiski pearõhulise ja rõhutu silbi omavahelises võrdluses. Katketooniga sõnade keskmine intensiivsus oli väiksem püsitooniga sõnadest. Erinevus loetud kõne ja spontaanse kõne vahel toob ilmekalt välja ka larüngalisatsiooni teguri häälde. Spontaanses kõnes esines katketooniga sõnades larüngalisatsiooni (vt nt joonist 7, pt 4.2.1.) tunduvalt vähem ja ka larüngalisatsiooni esinemiskoht pearõhulises silbis varieerus.

Kokkuvõte

Artiklites esitatud spontaanse kõne akustiline analüüs näitas, et liivi keele sõnaprosoodia peegeldab küll teatavaid ühisjooni nii eesti, läti kui ka taani keelega, kuid prosoodia põhistruktuur on siiski liivi keelele ainuomane.

Käesoleva väitekirja uurimistulemused osutavad, et mõned akustilised jooned võivad loetud ja spontaanses kõnes varieeruda. Samuti ilmnevad erinevused eri keelejuhtide häälduses.

Liivi kahesilbilistele sõnadele on iseloomulik rõhusilpide tugeva ja nõrga astme vaheldused. Püsitooniga nõrga- ja tugevaastmeliste sõnade esimeses rõhulises silbis kestuserinevust ei pruugi olla, kuid erinevus kahe sõnastruktuuri vahel ilmneb rõhutu silbi kestuse erinevuses ja sellest tulenevalt rõhulise ja rõhutu silbi kestussuhetes. See, et nõrga- ja tugevaastmelise struktuuriga sõnade hääldus võib siiski erineda, viitab kõneleajate erinevale taustale. Kahesilbiliste sõnade rõhuliste ja rõhutute silpide suhted sarnanevad küll teataval määral eesti keele omadega, kuid näiteks lühikese esisilbiga kahesilbilistes nõrgaastmelistes sõnades kaldub teise silbi poolpikk vokaal häälduma siiski pikemana kui eesti keeles. Nii nagu eesti keele on ka liivile iseloomulik taktiisokroonia.

Liivi toonisüsteemi puhul vastanduvad pikkades rõhusilpides püsitoon ja katketoon. Kahesilbilistes tugevaastmelistes püsitooniga sõnades varieerub põhitooni tipu asukoht, olles rõhulise silbi alguses või lõpus. Samas tugevaastmelistes katketooniga sõnades on põhitooni tipp valdavalt rõhulise silbi alguses. Spontaanses kõnest pärit andmed näitavad, et lühikese esisilbiga nõrgaastmelistes sõnades on põhitooni tipp pigem rõhutu silbi alguses.

Väitekirja uurimistulemused kinnitavad, et kõige iseloomulikum ja stabiilsem katketooni akustiline tunnus nii loetud kui ka spontaanses kõnes on põhitooni tipu asukoht pearõhulise silbi alguses. Põhitooni varajane langus rõhulises silbis tingib ka selle, et põhitoon rõhutus silbis on katketooniga sõnades madalam kui püsitooniga sõnades. Pikad helilised silbituumad võivad häälduda larüngalisatsiooniga, mis esineb aga järjekindlamalt loetud kõnes kui spontaanses kõnes. Intensiivsuse puhul on kõige iseloomulikum selle ebaregulaarne kontuur pearõhulises silbis. Pearõhuliste silpide keskmine intensiivsus püsi- ja katketooniga sõnades vähemalt spontaanses kõnes ei erine. Katketooni akustiliste tunnuste kirjeldamiseks tuleks aga kindlasti rohkem tähelepanu pöörata ka rõhutule silbile, mitte ainult pearõhulisele silbile.

Käesoleva väitekirja põhitulemused kinnitavad liivi sõnaprosoodilise süsteemi omapära ja erilist. Liivi keeles on säilinud sellised läänemeresoome keeltele iseloomulikud prosoodilised jooned nagu sõnaalguline rõhk ja lühikese ning pika häälikukestuse vastandus. Eriliseks teeb liivi sõnaprosoodia tasandi aga toonieristus, lühikeste ja pikkade diftongide ja triftongide esinemine ning erineva struktuuriga rõhuliste ja rõhutute silpide rohkus.

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