ESUKA – JEFUL 2014, 5–1: 261–292

SURVEY OF RESEARCH ON LIVONIAN PROSODY

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Abstract. The aim of the article is to give an overview of previous studies concerning Livonian prosody. In separate subsections a characterization of earlier treatments of the Livonian quantity and tone system will be provided. The Livonian prosodic system became the object of international discussion for the first time in the 19th century. The special status of Livonian tones was first noticed by the Estonian linguist Ferdinand Johann Wiedemann and later by the Danish linguist Wilhelm Thomsen. The first experimental studies of Livonian pronunciation were initiated in the 1920's, mainly due to interest in the broken tone. Previous descriptions appear to reveal a certain degree of agreement among researchers who have studied Livonian. Yet the traditional two-way quantity opposition view is being challenged by a ternary quantity distinction at the level of metric feet.

Keywords: Livonian, prosody, phonology, experimental phonetics, quantity, tone, stød

DOI: http://dx.doi.org/10.12697/jeful.2014.5.1.15

1. Introduction

The aim of this article is to give an overview of previous studies and descriptions dealing with the Livonian prosodic system. The prosody of Livonian is unique among the Uralic languages in that it contrasts (a) short and long monophthongs, diphthongs, and triphthongs, (b) prevocalic single and geminate consonants and word-final short and long consonants, and (c) lexical tones in stressed stem-initial syllables. Additionally, (d) different coda weight multiplies the number of possible sound patterns. All these aspects are actively used in inflectional morphology. Livonian also stands out among Finnic languages in that it contrasts final short and long vowels in stressed monosyllables.

Livonian prosody became the object of international discussion for the first time in the 19th century. It was the Estonian linguist Ferdinand Johann Wiedemann, interested in Finno-Ugric languages, who first noticed the special status of Livonian tones. Wiedemann (1861) clearly noticed the existence of different tones but explained them as specific vowel or consonant lengths similar to quantity contrasts

discovered in Estonian. He described (1861: 11) the phenomenon via the quantity relationships of Livonian vowels and consonants, comparing it to the opposition of Estonian long and overlong quantities. Wiedemann's explanation was based on the fact that long nuclear vowels with the broken tone are shorter than those with the plain tone (level or rising), and that coda consonants or coda vowels following a short nuclear vowel are shorter in words with the broken tone than in words with the plain tone.

A few decades later, in 1890, the Danish linguist Vilhelm Thomsen, in his doctoral dissertation, described the Livonian stød, claiming that it was similar to that of Danish. Thomsen noticed this interesting feature when he interviewed a Livonian sailor for Germanic loanwords in the Copenhagen harbour for 4–5 hours.

2. Historical background

From the historical point of view it is possible to differentiate the Livonian dialectal variations of Courland (lt *Kurzeme*) and Livonia (lt *Vidzeme*). A handful of person and place names and a phrase from the Livonian Chronicle by Henricus de Lettis are all that has survived of 13th century Livonian. At that time, the major Livonian settlements were situated in the central part of present day Latvia on the banks of the important rivers of Daugava and Gauja, and on the coast of the Gulf of Riga north of Daugava up to the Estonian settlements. This area was originally called Livonia. The next records of the Livonian language originate from the 17th century from the northernmost periphery of the historic Livonian settlement area near the river Salaca in northern Latvia and also from northern Courland. It was Thomas Hiärn, a historian of Swedish origin who, probably in 1665, wrote down some words from Salaca Livonian. More data about the Livonian language is available starting from the second half of the 18th century (see Winkler 1994, 1998). However, wars and assimilation processes caused a situation where in the 19th century the Livonian language was no longer spoken in this area. There is evidence of the last speakers of the Salaca dialect from 1868 (see Pajusalu 2011 regarding characteristic features of Salaca Livonian).

Starting from the second half of the 19th century, the linguistic focus has been on Courland. Courland Livonian is not completely homogenous. Traditionally, it has been divided into Eastern (spoken in the villages of Ūžkilā, Sīkrõg, Irē, Kuoštrõg, Pitrõg, Sānag, Vaid, Kūolka and Mustānum), Central (Īra) and Western Livonian (the villages of Lūž and Pizā) dialects.

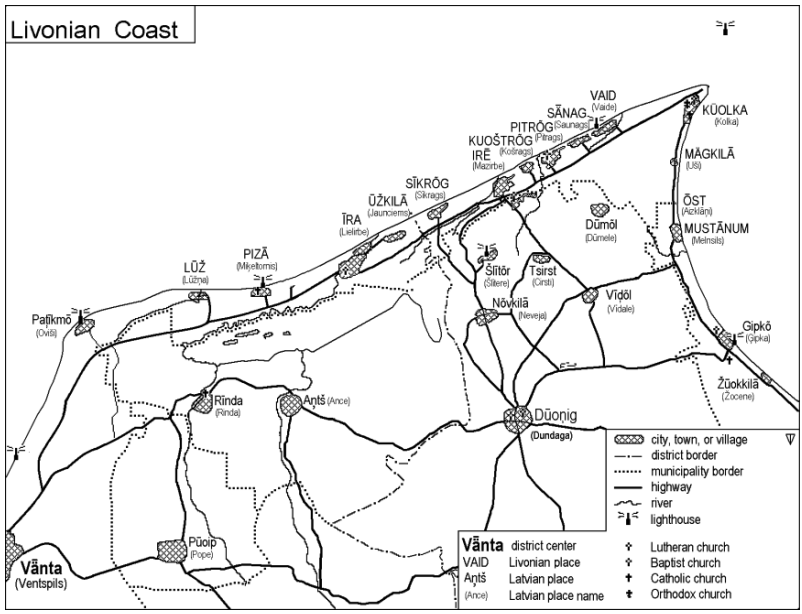

Figure 1. The Livonian Coast in Northern Courland (map by Tiit-Rein Viitso)

Regarding dialectal variation, the main difference lies between the East and the West, while Central Livonian forms a transition area. The basis of the Livonian written language is the Eastern Courland dialect (for a detailed overview of Livonian see Viitso 2008).

Historically, the Livonian language developed in the contact area of Finnic and Baltic languages. This southernmost Finnic language has preserved the main prosodic characteristics typical of a Finnic language such as (a) word-initial stress and (b) the phonological opposition of short and long phoneme duration. Livonian has developed such traits as (a) the broken tone, (b) the differentiation of long and short diphthongs, triphthongs, and (c) a large difference in the structure of stressed and unstressed syllables. Such special characteristics of Livonian have been in the focus of linguistic research, above all the broken tone or stød, which also has an equivalent in Latvian (for details see Markus 1991, Markus, Bond 2010). Similarly to Standard Estonian, Livonian has lost vowel harmony, although some traces have remained in older records of the Salaca Livonian dialects.

3. Sound structure of Livonian

There are 36 letters in the modern-day Livonian alphabet: a ä b c d ḑ e f g h i j k l ļ m n ņ o ȯ õ p q r ŗ s š t ţ u v w x y z ž. There are 8 vowels: /a ä e i o ȯ õ u/, of which /a ä/ are low and /i õ u/ high. The mid-high unrounded back-vowel /ȯ/ occurs only in a stressed syllable after word-initial consonants /p, m, v/, e.g. *pȯis* 'boy', *mȯizõ* 'manor'. All vowels can be long or short in the stressed position. East Livonian (except Kūolka) differentiates long [ō] and [ǭ][1], e.g. *tōvaz* 'sky' and *sǭra* 'horn'. In paradigmatic alternation, the mid-high rounded back-vowel [ō] can alternate with the diphthong *ou* and the low rounded back-vowel [ǭ] can alternate with short *a*, e.g. *tōvaz* (NSg) : *touvõd* (NPl) and *sǭra* (NSg) : *sarrõ* (PSg).

Various diphthongs and triphthongs are characteristic of Livonian. Diphthongs are classified as falling or rising on the basis of the quality of their components. The falling diphthongs are either short (*ie* and *uo*) or long (*īe* and *ūo*), whereas short falling diphthongs behave similarly to short monophthongs. Rising diphthongs are long and have either a long or short first component. In East Livonian all rising diphthongs with a long first component end in *i* (*āi*, *ōi*, *ǭ̄i*, *ȭ̄i*, *ūi*). Rising diphthongs with a short first component end in *i* (*ai*, *ei*, *õi*, *ȯi*, *ui*) or *u* (*äu*, *iu*, *ou*, *õu*). The final component of rising diphthongs with a long first component is short, and of rising diphthongs with a short first component is either long or short. The long final component in a syllable with the plain tone is clearly longer than the first component, in syllables with the broken tone equal or somewhat longer. Triphthongs begin as rising diphthongs and end as falling diphthongs. Prosodic distinctions occurring in the Livonian diphthong and triphthong system are reflected in the following series:

Table 1. Livonian diphthongs and triphthongs.

Short first component			Long first component	
Short final component	**Long final component**	**Broken tone**	**Plain tone**	**Broken tone**
aigā 'edge, NSg'	*aigõ* 'time, PSg'	*a'igõ* 'edge, PSg'	*āiga* 'time, NSg'	*lǭ'igi* 'asunder'
kuoigīd 'ships'	*luoimõ* 'warp, PSg'	*kuo'igõ* 'ship, PSg'	*lūoima* 'warp, NSg'	*tū'oigõz* 'birch bark'

1 Orthographically, both vowels are marked as *ō*.

The dialectal differences of Courland Livonian are clearest if one looks at vowels. In East Livonian there are 8 short and 9 long vowels in the primary stress, in Central Livonian (Īra) 8 short and 8 long vowels, and in West Livonian 6 short and 6 long vowels. In the 19th century, the short and long rounded front-vowels *ü* and *ö* were in use as well. They were replaced in the whole area with unrounded *i* and *e* in the end of the 19th century.

Unlike many other Finnic languages, Livonian has voiced stops /b d ḍ g/ and fricatives /z ž/. Similar to Estonian, Livonian has palatalization of alveolar consonants which has occurred in front of the historical /i/ and /j/. In contemporary Livonian, /ḍ ţ ļ ņ ŗ/ have acquired a phonemic status. The following /i/ and /j/ have caused the appearance of the palatal /š/, /tš/, /ž/ and /dž/. The consonants *f* and *h* occur only in loanwords and *h* also in interjections. A distinct aspect in Livonian as compared to other Finno-Ugric languages is the gemination[2] of voiced plosives and fricatives. The structure of consonant clusters in Livonian is more complicated than in Finnish or Estonian.

The length of a vowel is orthographically marked with a macron above the vowel: *lēņtš* ‘southwest’, *sīedõ* ‘to eat, Inf’. The length of the vowel of the second syllable after a short first syllable is also marked: *jõvā* ‘good’, *katāb* ‘he/she covers’. Consonant length is denoted by spelling the consonant either with one or two letters as e.g. *ka’ggõl* ‘neck’, *võttõ* ‘to take’. However, the short geminates of voiceless stops are written, like in Estonian, with a single letter, e.g. *võtāb* [*võt̆tàʙ*] ‘he/she takes’. Also, a single voiceless fricative in an intervocalic position is a short geminate as e.g. in the word *täsā* ‘here’. In word-final position, long consonants in Livonian are written with a single letter: e.g. *rõk* ‘talk, speech’, *tas* ‘cup’ (a detailed overview of the development of Livonian orthography can be found in Ernštreits 2013).

Livonian is the only Finnic language that differentiates two tones in stressed stem-initial syllables. The plain or level tone is characterized as rising and the broken tone or stød as rising-falling. The opposition of the F0 contour in a stressed long syllable is a central phenomenon in Livonian word prosody. In addition to the characteristic tone contour, laryngealization can supervene. The transcription of Livonian used, for instance, in dictionaries denotes the broken tone with an apostrophe following the vowel of the stressed syllable, e.g. *nä’g* ‘dream’, *vi’zzõ* ‘closed’. Although in the common orthography the broken tone is left unmarked, it is sometimes implied by orthography. Namely, /b, d, ḍ, g, z, ž, v, j/ at the end of a primary stressed

2 The criteria for gemination here is that the geminate sequence in the syllable boundary is divided into two syllables.

syllable after a short vowel or short lowering diphthong indicates broken tone, while /p, t, ţ, k, s, š/ in the same position indicates plain tone. The prominence of this phenomenon should not be ignored, as stød has a phonological role in differentiating meaning, e.g. *kallõ* 'island, PSg', *ka'llõ* 'fish, PSg'. At the same time, alternation of plain tone and broken tone is substantial in the paradigmatic alternation of some words, e.g. *sõbrā* 'friend' : *sõ'brõ* 'friend, PSg'.

4. Syllable structure and gradation

A primary stressed syllable in Livonian is either short or long. Short and long stressed syllables have a different prosodic structure because of the contrast of two lexical tones and because of complicated quantity patterns, which vary depending on the length and tonal characteristics of stressed syllables.

The domain of the Livonian gradation is a regular alternation of the strong-grade and weak-grade stressed syllables and unstressed syllables. The essence of Livonian gradation is thoroughly described and explained by Tiit-Rein Viitso (2007b). On the basis of co-occurrence in inflectional paradigms of weak- and strong-grade stem types he establishes the main types of gradational paradigms.

The general scheme of Livonian syllable structure in his study (2007b: 47) includes an optional consonantal onset, an obligatory rhyme and optional termination. The rhyme includes at least a nucleus, which in a stressed syllable can be followed by a coda, and is accompanied either by the plain (or rising) or the broken tone in the primary stressed syllable. On the basis of the analysis, three structural types of Livonian gradation can be established (2007b: 49): (1) 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* [*kalàɒ*] 'fish, NPl' and *ka'llõ* [*ka'llə̂*] 'fish, PSg', *tiegūd* [*tʲegùɒ*] 'face, NPl' and *tie'ggõ* [*tʲe'ggə̂*] 'face, PSg'; (2) 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* [*kiǩkìɒ*] 'cock, NPl' and *kikkõ* [*kìkkə̂*] 'cock, PSg'; (3) 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* [*lùoĭkə̂ɒ*] 'hollow; valley, NPl' and *luoikõ* [*lʷoìkkə̂*] 'hollow; valley, PSg'.

Differentiation of weak and strong grades was also detected by Lauri Kettunen (1938: XXII, 1947: 23), when he compared such disyllabic words as *jālga* : *jaĪgə̂* ‘leg, NSg : PSg’, *āmbaz* : *am̃bə̂ɒ* ‘tooth, NSg : NPl’ etc.

In the analysis of the phonology of Livonian stød, Paul Kiparsky (2006: 11–12) maintained that the prosodic system of Livonian, like that of other Finnic languages, is based on syllable weight. He considered the main foot type to be a moraic trochee. This has caused the lengthening of a stressed syllable in cases where the unstressed syllable was phonologically long (*va’ddə* < **vataa*) in order to avoid the LH (rising) sequence. Kiparsky considered such lengthening to be related to the development of stød.

Kiparsky (2006: 9) also pointed out that in Livonian all short consonants in an intervocalic position are voiced. Their geminated counterparts, such as *vigà* : *vi’ggə* ‘fault, desease, NSg : PSg’, are similarly voiced and able to carry a tone whereas the equivalent heavy syllable gets stød. Additionally, Kiparsky identified super-heavy syllables, claiming that every stressed CVR syllable (R = a sonorant) is superheavy at least phonetically, with the extra length residing either on the R or the V, depending on the gradation environment.

Feet in Livonian can be one to three syllables long. Together with Finnish, Livonian is the only Finnic language having stress on the first syllable of the stem. This is valid also in foreign words. Only verb prefixes borrowed from Latvian can be unstressed, e.g. *no|võttõ* ‘remove, Inf’. Long-syllable prefixes have a similar stress as the stem, e.g. *at|andõ* ‘give back, Inf’. 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, e.g. *mǭnikā* ‘peasant’.

5. Research on quantity and tone

The first considerably thorough treatment of Livonian word prosody was provided by the Finnish linguist Lauri Kettunen, who in 1925 carried out the first acoustic-phonetic study of Livonian. This experimental study of Livonian pronunciation was initiated mainly by the interest in the broken tone and was carried out in the phonetics laboratory of the University of Tartu, where the pronunciation of one informant was analysed. Kettunen continued his studies later as well (Kettunen 1938, 1947, 1960), but not in the frame of experimental phonetics.

However, there is a particularly interesting study on Livonian quantity that has received too little attention. It was a student of Lauri Kettunen at the University of Tartu, Paulopriit Voolaine, who in 1922 obtained the first prize for his experimental-phonetic study on Livonian quantity. Although there is a lack of information about the research method, it turns out from his descriptions that the study was carried out using the kymograph. Voolaine was very precise in measuring the durations of the segments and the ratios of the segments and syllables. His conclusions based on the material are perfectly comparable to the following studies on Livonian prosody, though sometimes they are rather scarce.

Noteworthy phonetic and phonological studies on Livonian were carried out by the following researchers: Lauri Posti (1936, 1937a, 1942), Aarni Penttilä and Lauri Posti (1941), Marilyn May Vihman (1971), Seppo Suhonen (1982), Paul Kiparsky (2006), Ilse Lehiste et al. (2007, 2008), and Tiit-Rein Viitso (1981, 1997, 2007b, 2008).

Until 2008, experimental studies were based on the data collected from one speaker (except Suhonen 1982), whereas afterwards most studies have used material from more than one speaker.

Table 2. Number of Livonian speakers included in the phonetic-acoustic studies.

Author(s)	Year(s)	Number of speakers
Voolaine	1922	1
Kettunen	1925	1
Posti	1936	1
Penttilä, Posti	1937, 1941	1
Vihman	1971	1
Suhonen	1982	3
Pajupuu, Viitso	1986	1
Lehiste et al.	2008	8
Teras, Tuisk	2009	2
Tuisk, Teras	2009	8
Tuisk	2012	4

It should also be noted that almost all experimental studies on Livonian prosody have used controlled speech (i.e. frame-sentences and test-words). In recent years the focus has been on spontaneous speech (Tuisk, Teras 2009, Tuisk 2012). The Livonian prosodic

system has been compared to that of other Finnic languages as well as other Finno-Ugric languages (see for instance Markus et al. 2013).

In the following two subchapters, temporal and tonal characteristics of Livonian will be observed separately and the main statements or research results from different researchers will be presented. The most confusing factor concerning the description of the broken tone in Livonian is the use of different terms. This is probably due to the different interpretation of the phenomenon as well as the use of the language to describe it and the tradition of the certain research group. When talking about the tone or intonation, English *broken tone*, *broken intonation* or *glottalized tone*, German *Stosston, gestossene Intonation*, Danish *stød*, Estonian *katketoon*, Finnish *katkointonaatio* etc. is used. In case of a segmental feature, English *glottal stop*, German *der Bruch der Stimme*, *Stimmbruch* or *Stosslaut*, Danish *stød*, Estonian *katkehäälik*, Finnish *katko*, French *coup de glotte* etc. is used. Also, English *laryngealization*, *glottalization* or *creaky voice* is in use to describe irregular vibrations of the vocal folds. Despite the question of terminology, there always seems to be an agreement in the opposition of the presence and absence of this phenomenon[3].

5.1. Temporal characteristics

In his research, Paulopriit Voolaine (1922) separately observed words with open and closed syllables, different vowels, short and long monophthongs, diphthongs and triphthongs. He found (1922, 'vowels': 1) that there is a half-long vowel in the second syllable of polysyllabic words with a short first syllable, e.g *kalà* 'fish', *kaḷàgə̂ᴅ* 'seagull, NPl'. Comparing (1922, 'vowels': 25) vowels in the first syllable in such word types like *sōpkə̂ᴅ* 'boot, NSg' and *äpt̄ə̂ʙ* 'he/she helps', the vowel in the first type was twice as long as the vowel in the second type. In the descriptions of diphthongs in the first syllable of disyllabic words, he opposed (1922, 'vowels': 33) a short component and a "half-long" component, e.g. *sᵘor̄m* 'finger' and *sùormə̂ᴅ* 'finger, NPl'.

Concerning consonants, Voolaine also measured the durations of the word-initial consonants. He noted (1922, 'consonants': 2, 7) that the short consonants in such words like *lugùʙ* 'he/she reads' and *kuodà* 'house' are voiced and can occur as short, mid or long geminates, e.g. *lu'ggə̂* 'to read'.

3 In the following simply *words with stød* or *broken tone* is used, if not specified otherwise.

Lauri Kettunen (1925: 11) also pointed to the fact that if the vowel of the first syllable is short and is followed by a short consonant or a weak (in other words short) geminate, the vowel of the second syllable is half-long: *i̯zà* 'father', *oppùв* 'he/she studies'. A half-long vowel can also occur after the strong secondary stressed syllable, e.g. *i̯ālganikkà* 'pedestrian', *pālvalikkìst* 'sun, PSg'. The vowel in the second syllable is always short when there is a long vowel in the first syllable, e.g. *pàikkaᴅ* 'places' (1925: 12). He also noted that the diphthongs take part in the quantity and quality paradigmatic alternation, e.g. *pài̯kka* 'place, NSg', *pai̯kkâ* 'place, PSg, IllSg', *tùi̯maᴅ* 'benumbed, NPl' : *tui̯mâ* 'benumbed, PSg' (1925: 12), *àiga* 'time, NSg' *aigõ* 'time, PSg' (1947: 26). He noticed that triphthongs are longer in the strong grade, e.g. *sùo̯imâв* 'he/she berates' : *sʲo̯imâ* 'to berate, Inf' (1925: 13).

Kettunen (1925: 6–7) divided word-final stops into three quantities: after a short vowel long (*kulʹ* 'hawk', *päpʹ* 'priest'), after a long syllable as well as further in a word half-long (*oùk* 'hole', *nīt* 'meadow', *i̯õraš* 'in the lake') and short (*kaštùG* 'dew'). According to Kettunen, in the case of *stimmbruch*[4] the word-final consonants can either be shorter (*stimmbruch* is distinct, e.g. *a'm* 'coat') or longer (*stimmbruch* is simply weak, e.g. *a'mm̄*) in quantity. Kettunen was the first to notice that the Livonian stops and *s* occur after a short vowel in a paradigmatic relationship with short and long geminates, e.g. *kattâ* 'to cover, Inf' : *kattàв* 'he/she covers'. The rest of the consonants occur as geminates only in the strong grade, e.g. *kʲellâ* 'clock (PSg)' : *kìe̯la* 'clock'.

Kettunen (1925: 8–9) maintained that after a vowel with *stimmbruch* all voiced consonants can occur as geminates. The quantity of a geminate seems to depend on the strength of the *bruch* but is on average "middle-long" (*mittellang*): *ma'ggâ* 'to sleep', *pe̯'ddâr* 'moose'. After a short vowel a consonant in the strong grade is lengthened but in the weak grade the consonant is short and the vowel preceding a voiced consonant is lengthened, e.g. *okkõsâ* 'branch, PSg' : *oksàᴅ* 'branches, NPl', *rañdâ* 'shore, PSg, IllSg' : *rānda* 'shore'.

Though Lauri Posti's study in 1936 was focused on Livonian intonation, some statements about quantity can be found. Similarly to Kettunen, Posti (1936: 322–323) is also of the opinion that if the vowel of the preceding stressed syllable is short and the intervocalic consonant has a short quantity, a half-long vowel can occur in the second or fourth syllable of the word. It is possible for broken intonation to occur in an unstressed half-long vowel, but according to

4 The orthography here and further is preserved as it is in Kettunen 1925.

Posti, this can happen only in East Livonian. The absence of stød (*katko*) in the vowel of the second syllable in West Livonian, in Posti's opinion, is related to the fact that the vowel of the first syllable in West Livonian is slightly longer than the first syllable vowel in East Livonian. In front of a voiced consonant, the first syllable seems even longer than in front of a voiceless consonant. This kind of 'stretching' of the first syllable causes the vowel in the second syllable in West Livonian to be shorter than that in East Livonian. Oppositions of short and long sounds were also presented by Posti in his thorough dissertation on Livonian sound history (Posti 1942).

Marilyn May Vihman's unpublished doctoral dissertation (1971) deals with the complex morphophonological alternations of Livonian and their phonetic characteristics. She used the recordings of Silvija Rudzītis (nee Berthold), a war refugee from the Eastern Livonian village Vaid. Vihman (1971: 73–75) pointed out that though both voiced and voiceless obstruents occur medially in Livonian, at the lexical level there is no reason to posit such a contrast. In fact, the phonetic contrast [*p* : *b*], [*t* : *d*] etc. in final position is one of tenseness, the voiced member of the pair being relatively less tense than the voiceless member. She has also stated that all obstruents may be said to occur both singly and as geminates in a medial position, and as non-geminates initially, in root morphemes.

Vihman explained (1971: 92–94) that obstruent clusters not preceded by a sonorant enter into consonantal length alternation after a lexical short vowel: e.g. *lip·sə* 'to milk' : *lipsa·b* 'he/she milks', *riš·t* 'cross' : *rišti·d* 'cross, NPl' *tap·ə* 'to kill' : *tapa·b* 'he/she kills'. She analyses that where the first member of a consonant cluster is a glide, the glide tends to be lost after the preceding vowel has been lengthened, e.g. *lo·da* 'table' : *low·də* 'table, PSg', *ej·tə* 'to throw/build' : *e·tab* 'he/she throws/builds'.

Questions of Livonian phonology have been studied in great detail by Tiit-Rein Viitso (1974, 1975, 1981, 2008[5]). He has established the main types of tone and quantity patterns and explained prosodic alternations in Livonian words using the complex notion of word accent, which combines stress, tone, and quantity. He distinguished (1981: 27) heavy, broken, and light accents in Livonian. Viitso's phonological analysis (2008: 313) divided the Livonian diphthongs into falling (opening) and rising (closing) according to their quality. Falling diphthongs are either short (*ie* and *uo*, e.g. *piezā* 'nest, NSg', *suo'ddõ* 'war, PSg') or long (*īe* and *ūo*, e.g. *tī'edõ* 'to do', '*kūona* 'frog'). The total duration of short diphthongs is equal to the duration

5 Includes also the supplemented version of Viitso 1981.

of short monophthongs. Rising diphthongs are long and can be divided into those with a long initial component (e.g. *āi* as in *āiga* 'time') and those with a short initial component (e.g. *ei* as in *leibõ* 'bread, PSg').

Triphthongs occur in the following forms: *ieu*, *uoi* and *ūoi*, e.g. *kieuž* 'rope', *ruoikõ* 'to hurry', *lūoima* 'warp'. In West Livonian the triphthong *īeu* has occurred (as in *līeudab* 'he/she finds'). Livonian triphthongs developed through the 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: 28).

Viitso (1981: 13–14) presented an opposition of a short monophthong, a long monophthong without stød and a long monophthong with stød in stressed syllables of monosyllabic words, e.g. *li* 'go!', *sī* 'fault', *rī'* 'threshing barn'. An analogical three-way opposition can also be found in some idiolects for diphthongs. Viitso maintained that disregarding the tonal differences, Livonian monophthongs occur in two lengths and resonants in three lengths which are comparable to those of Estonian. The resonants include a short consonant, short geminate and long geminate, and the vowels a short and long vowel.

Viitso (1981: 15) explains that (1) geminates occur only after a short vowel and thereby in front of a short monophthong (the latter not being absolute, e.g. in Kettunen's dictionary in 1938 the word *ńuŕrà-ńuŕrà* is registered), (2) after a short vowel in a disyllabic word, a single consonant occurs always and only in front of a half-long vowel and never with stød and (3) there is no opposition of a short and long consonant at the end of a word. This, according to Viitso provides two possible interpretations to geminates in Livonian: (1) geminates represent phonological geminates, i.e. sequences consisting of two identical phonemes; (2) geminates and word-final single consonants equivalent to geminates represent long consonant phonemes which generally are in opposition with short consonant phonemes.

Seppo Suhonen (1982) carried out his experimental study on the quantity of Livonian vowels at the University of Helsinki, using three speakers from Eastern Livonian as informants. His results are largely similar to those by Kettunen (1925) and Penttilä-Posti (1941). Suhonen (1982: 298–299) maintained that in the case of short vowels, in a closed first syllable the short vowel in disyllabic words is longer in words with stød than in words without stød. In mono- and trisyllabic words the short vowel is shorter. Furthermore, the duration of a short vowel is not in correlation with the openness of the syllable. In trisyllabic words, according to Suhonen's measurements and unlike Kettunen's measurements, the vowels in both closed and open syllables are shorter than in disyllabic words.

Regarding long monophthongs and diphthongs in the first syllable (Suhonen 1982: 302–304), the overall conclusion was that the vowels with stød are shorter than the vowels without stød. As to long diphthongs a somewhat interesting result emerges. Namely, comparing diphthongs with a long first vowel (such as *ài*, *ùo*, *ìe* and *ìu*) and with a short first vowel (*aì*, *eì*, *e̯i* and *e̯u*) it appears that in both cases the first component of the diphthong is longer than the second. Suhonen was of opinion that this result can be explained by the differences between open and closed vowels, but remains careful in making a definitive statement. He also presented results on so-called broken diphthongs, e.g. *ⁱe*, *ᵘo*, *ⁱĕ*, *ᵘŏ* (1982: 305). In his material, the first component comprises 43% of the diphthong.

Hille Pajupuu and Tiit-Rein Viitso's spectrographic study (1986) on Livonian polyphthongs (i.e. diphthongs and triphthongs) dealt with the acoustic characteristics of historic polyphthong classes. The data of the study was recorded from the East Livonian speaker Pētõr Damberg. The method used for the research involved reading the frame sentences with the test words containing polyphthongs in the first syllable. The results of the study uphold Viitso's analysis on Livonian phonology. It was noted (1986: 112–117) that similarly to monophthongs, quantity is also distinctive in polyphthongs. An important result concerning Livonian word prosody was a claim that similarly to Estonian, in Livonian there exists an inverse proportionality between the vowels of the second and the first syllable: a (half-)long vowel in the unstressed second syllable appears only in words with a short polyphthong in the preceding syllable, i.e. *aigõ* [*aìgə̂*] : *aigā* [*aĭgà*], *luoimõ* [*lŭoìmə̂*] : *kuoigīd* [*kŭoĭgìɒ*].

The results also showed (1986: 113) that in polyphthongs with a short initial component (in *kuijõ-*, *luoimõ-*, *ke'itõ-*, *kuo'igõ-*type of words), the first two components had a more or less equal duration (V1=146 ms and V2=133 ms), whereas in polyphthongs with a long initial component (in *rūimõ-*, *lūoikõd-*, *tū'oigõz- kīeta*-type of words), the first component was about twice as long as the second component (V1=250 ms and V2=139 ms).

An essential study on Livonian word prosody was carried out within the framework of the project concerning the Finno-Ugric languages by Ilse Lehiste et al. (2008). The main goal of this multifaceted experimental phonetic study was to give an overview of the main prosodic characteristics of Livonian based on an acoustic analysis of the speech of eight Livonian speakers. Previously, Livonian had usually been described as having an opposition between short and long vowels in the stressed first syllable, which would suggest only a two-way opposition. But previous studies had not looked at the

durational ratios between syllables. It appeared that at the level of metric feet, like Estonian, Livonian too has a ternary opposition, but it is achieved by different means.

Namely, in the realization of words with vocalic quantity, a three-way quantity opposition like in Estonian also appeared in Livonian, manifested by the temporal ratios of the two syllables of the metric foot. According to the results (Lehiste et al. 2008: 41), the metric foot consisting of a short syllable followed by a half-long syllable (cf. *kadūb* 'disappears', *tiegūd* 'faces') had a V1/V2 ratio (0.5–0.7) similar to that of Estonian words in Q1 (0.5–0.8, see for example Lehiste 1960, 1997, Lippus et al. 2013). It occurred that the duration of the short diphthong in Livonian was somewhat longer than that of the short monophthong. Still, the durational structure was comparable.

There were two kinds of metric feet with a long first syllable (Lehiste et al. 2008). In words with a long open first syllable and a half-long second syllable (cf. *vȭrõz* 'stranger', *pū'dõz* 'clean'), the ratios are comparable to the ratios of Estonian Q2 words (1.0–1.8 in Livonian and 1.2–2.0 typically for Estonian). When a long first syllable was followed by a short second syllable (cf. *kȭrõ* 'wheel, PSg', *rǭ'dõ* 'money, PSg'), the syllable ratios were comparable to those of Estonian Q3 words (2.4–3.2 in Livonian and typically 2.0–3.9 in Estonian).

There is a ternary contrast of consonant duration in Livonian, found not only in Estonian but also in Ingrian and Inari Saami (Markus et al. 2013), e.g. *kudā* 'knit, Imp2Sg', *sutā* 'wolf, PSg', *kattõ* 'cover, Inf'. Similarly to Estonian, Ingrian and Inari Saami (2013: 230, 233), the duration of the first syllable vowel was not influenced by the following consonant duration in Livonian. In all four languages the duration of the second syllable vowel was inversely related to the duration of the intervocalic consonant (the longer the consonant, the shorter the vowel). However, the three consonant durations were not equally spaced in the four languages. In Livonian, a short consonant appeared to be significantly shorter than a short geminate, and a long geminate was significantly longer than a short geminate consonant. The ratio between a single consonant and a short geminate was smaller than the ratio between short and long geminates.

Tuisk and Teras (2009) studied the role of duration ratios and fundamental frequency in spontaneous Livonian. The analysis of the speech of six speakers showed variation between speakers. One group of speakers did not differentiate words similar to Estonian Q2 and Q3 (Q2 – 2.72, Q3 – 2.85), while the other group did (Q2 – 2.22, Q3 – 2.84).

An additional acoustic-phonetic investigation was carried out focussing on the realization of the temporal and tonal characteristics of disyllabic words consisting of a short first syllable and a half-long second syllable (CV.CV̀ structure) in Livonian spontaneous speech. The results (Tuisk 2012) were somewhat similar to the ones found in read speech (Lehiste et al. 2008). Thus, the durations of the syllables and duration ratios remained stable in both read speech and spontaneous speech. The duration of the second syllable turned out to play an important role, suggesting that a longer V2 duration is closely related to a later alignment of the F0 turning point (2012: 8). It appeared (2008: 7), that the turning point of the fundamental frequency in disyllabic words with a short first syllable and a half-long second syllable was usually at the beginning of the second syllable, which is a similar situation to that found in spontaneous Estonian (Lippus et al. 2013).

5.2. Tonal characteristics

According to Vilhem Thomsen's observations (1890: 58–63), Livonian stød occurs in heavy syllables that end in what he called a 'sonant coefficient' and it interacts with quantitative gradation in morphological paradigms.

Paulopriit Voolaine observed words with stød in his materials, but he explained it as the influence of 'an aspiration' (1922, 'vowels': 39). In his study (1922, 'consonants': 41) the term 'aspiration' was corrected to be *katke*, probably by his supervisor Lauri Kettunen or someone else who assessed his work. He stated that aspiration is noticed only after the first syllable. He analysed (1922, 'vowels': 40) the influence of the aspiration on the quantity of vowels and found the vowel before the aspiration to be longer than the vowel after the aspiration, e.g. in *sä'u*. Voolaine (1922, 'consonants': 41–42) found this kind of aspiration to be short and rather vague, not as strong as for example in the Setu dialect of Estonian. Aspiration was clearest in vowels and before voiced consonants. He also found that aspiration shortens vowels.

Lauri Kettunen (1925: 4) described the Livonian broken tone as the so-called breaking of the voice (*der bruch der stimme* or *stimmbruch*) or *stosston*. Tone, according to Kettunen, is manifested by the voice breaking in the middle or the end of the sound. In the phonetic transcription Kettunen used an apostrophe (') to mark this phenomenon. For the plain tone he did not propose any specific term.

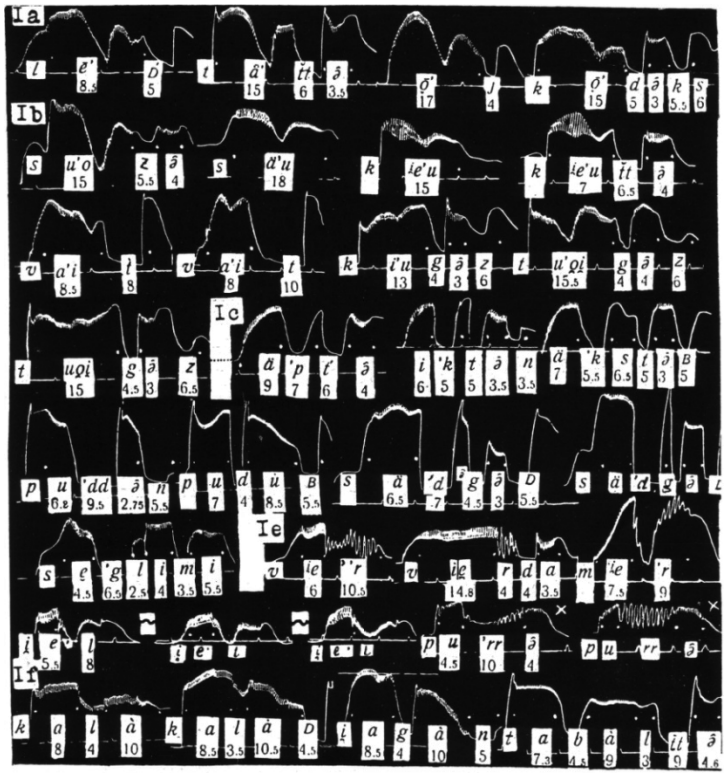

Figure 2. Example of Kettunen's kymograms of words where *stimmbruch* was expected: Ia – long monophthongs, Ib – diphthongs and triphthongs, Ic – in front of a voiceless stop, Id (the fifth line) – in front of a voiced stop, Ie – in front of a liquid, If – in non-initial syllables. The durations of sounds are given in centiseconds. (Kettunen 1925: 19–20)

Kettunen did not observe *stimmbruch* in front of a voiceless stop and in non-initial syllables, but he does not deny the possibility of its occurrence in such cases (1925: 19). He was of the opinion that in East Livonian *stimmbruch* can also occur in non-initial syllables, but acknowledged this occurrence to be quite haphazard (1925: 5).

The kymograms showed (Kettunen 1925: 4–5) the position of *stimmbruch* in long vowels, diphthongs, triphthongs and in cases where a vowel is followed by a liquid[6]. In long vowels, *stimmbruch*

6 In the kymograms, the breaking of the voice is visible as a so-called valley, whereas the depth of the valley varies.

occurred towards the end of the vowel. In diphthongs and triphthongs, according to Kettunen, the breaking of the voice was audible between the vowels, and the same was true if a short vowel is followed by a voiced consonant. Although Kettunen did not detect *stimmbruch* in front of a voiceless stop, *s* and *z*, he claimed that it was still manifested by a sudden break in voice. In the beginning of voiced consonants, *stimmbruch* could be noticed immediately after the vowel. Kettunen believed that there were dialectal differences in the manifestation of the Livonian broken tone whereas the broken tone appeared most prominently in East Livonian. He also maintained that in East Livonian *stimmbruch* could also be found in non-initial syllables, but admitted it to be quite haphazard.

In the 1930s there was a vivid debate on Livonian intonation in the magazine *Virittäjä* between Lauri Kettunen and his student Lauri Posti. Posti (1936: 316) found it odd that the so-called *katko* (German *Stoss*, Danish *stød*, French *coup de glotte*, English *glottal stop*), which is such an important factor in the phonetic structure of Livonian, can often be completely absent or appear in such a weak form that it is barely audible. Still, it is an element differentiating meaning. According to Posti, a word does not need to contain an audible *katko* but words can differ in their intonation. He pointed out that Kettunen had often left this phenomenon in the first syllable unmarked. This was due to the fact that Kettunen simply had not heard it.

Lauri Posti carried out his first acoustic studies of Livonian tones in 1936 at the University of Riga using Eastern Livonian speaker Rosalie Dziadkowsky from Pitrõg village as an informant. With the help of Latvian phonetician Anna Ābele, he studied the word tones of Livonian and Latvian[7]. Posti distinguished rising, broken and falling intonation in line with the Latvian tradition and used the terms traditionally used for Latvian tones, cf. Finnish *nousuintonaatio* 'rising intonation' (Latvian *stieptā*/*kāpjoša intonācija*, German *steigende Intonation*, French *l'intonation ascendante*), *katkointonaatio* 'broken intonation' (Latvian *lauztā intonācija*, German *gestossene Intonation*, French *l'intonation rude*) and *laskuintonaatio* 'falling intonation' (Latvian *krītošā intonācija*, German *fallende Intonation*, French *l'intonation descendante*). Posti (1936: 320) claimed to have found falling intonation "in words with late irregular lengthening", e.g. *jārandiz* 'away', *āt̀* ~ *āt̀ə̂* (~ *at̀tə̂*). Posti (1936: 318) explained that if the long primary stressed syllable is voiced, it can have one of these

7 Note that the Latvian phonetic tradition did not distinguish between tone and intonation.

three intonation types. Posti presented oscillograms of the F0 contours of the rising and broken tone of the 24 minimal pairs.

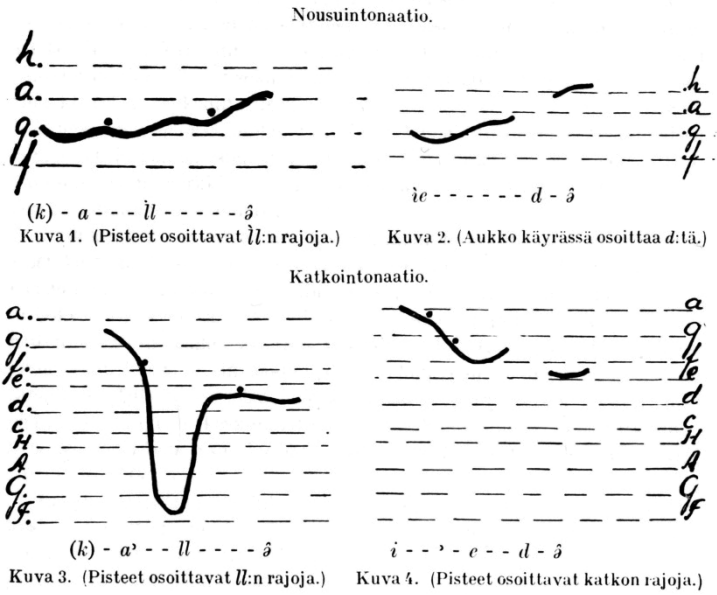

Figure 3. **Example of words** with rising (above) and broken (below) intonation (Posti 1936: 319)[8]

Posti's results (1936: 318–320) revealed that in the case of rising intonation the F0 contour rises about 1–2 semitones. In disyllabic words the F0 was usually higher than in the first syllable. It is noteworthy that Posti considered the sentence intonation to be significant and stated that in fluent speech, if the sentence intonation is falling, the F0 contours can remain stable or slightly falling. In the case of broken intonation, the F0 contour began 1–2 semitones higher than in rising intonation. In the beginning the F0 slowly falls and in the presence of stød (*katko*) the fall is bigger, around an octave. Such falling can continue until the end of the syllable or, more commonly, rises abruptly, remaining just a little lower than in the beginning of the syllable. According to Posti, a complete break in the sound/tone of the broken intonation was very uncommon. In words with a high vowel or a diphthong (e.g. *ū*, *ie*), the fall in stød could be relatively small and

8 Posti had no figure of the falling intonation (Posti 1936: 320).

stød itself quite short. He stated that in the case of long voiced secondary stressed syllables there was a falling intonation, but if there was a half-long vowel, it "got a broken intonation", e.g. in words *izà'* 'father', *muštà*' 'black'.

Posti maintained (1936: 322–323) that the first consonant after a short vowel is always voiced in a stressed syllable with broken intonation, e.g. *jŏgst* 'river, ElSg' (Kettunen 1925: 1 *su'kst* 'gender; relative'), in other words, before a fully voiceless consonant stød is not possible. Similar transcription was used both by Thomsen (1890) and Setälä (1953). Posti also stated that the "intonation" in a long unstressed syllable is never glottal. Rather interesting is the notion that there appeared to be a short intonation (German *Kurzintonation*) in short voiced syllables.

Posti (1936: 321) presented several new ideas concerning phonetic transcription in Livonian (e. g. ˘ for broken intonation, ˆ for rising intonation and ¨ for falling intonation), with which Lauri Kettunen (1936) in his reply to Posti's article, however, disagreed, and Kettunen also corrected some word forms presented by Posti. Unlike Posti, Kettunen maintained (1936: 491–492) that stød can definitely appear before the voiceless consonant. In defence of his transcription, he admitted that in cases of incomplete glottal closure, voicing may continue into a following consonant. Still, he found it very strange that in cases of full glottal stop even the first part of a voiced obstruent fits between a voiceless glottal stop and a voiceless consonant.

In 1937, Lauri Posti carried out a joint study together with Professor Aarni Penttilä where they present the Livonian intonation types on the basis of the F0 contours determined by oscillograms of Pētõr Folmaņ from the Eastern Livonian village Sīkrõg. Posti's article (1937a) and comments (1937b) were a response to Kettunen's reaction. The most important part is a set of 12 kymograms. This time, four kymograms concerning falling intonation in Livonian were presented as well.

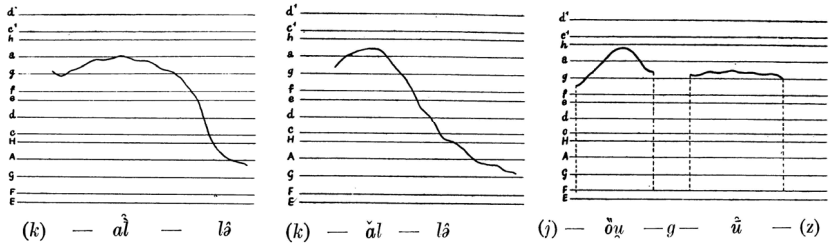

Figure 4. Examples of words with rising, broken and falling intonation (Posti 1937a: 190–191)

Comparing (1937a: 192) the word pairs with rising and broken intonation, the pitch contour rises until the end of the first syllable in the case of rising intonation, but in broken intonation the F0 rises until stød and then falls rather abruptly. Although it is not possible to determine the precise beginning point of stød on the basis of Posti's paper, it can be deduced that the stød starts in the middle of the long vowel or a little bit before its middle, and that the vowel with stød seems to be slightly shorter than the vowel without stød. Posti explained that the falling intonation begins with a rise and ends in a fall. When speaking about broken intonation, Posti similarly divided it into two parts: the rise and the fall.

In his reply to Kettunen, Posti (1937a: 199) argued that a glottal stop cannot be termed voiceless in the same sense as a true consonant and that he is unwilling to regard the glottal stop as a sound. Complete glottal closure occurred extremely rarely in their oscillographic record, though the stød articulation was perceptually very clear.

The characteristic pitch contour in the case of falling intonation was smoother than in broken intonation (1937a: 192–193). Again, Posti conceded that falling intonation in the first syllable is rather rare. Posti admitted that words with a short first syllable and a half-long second syllable, such as *aĭgă̆* 'edge', *laĭgă̆* 'broad', were not pronounced with the falling intonation. Furthermore, he was of the opinion that such words carry short intonation, the intonation that is characteristic of a short single vowel.

Kettunen (1937: 313), in his response to Posti's article (1937a), maintained that in Posti's kymograms for rising intonation the pitch in the second syllable was lower than in the first syllable. Later he added (1937: 314) that the pitch was mostly plain (Finnish *tasaintonaatio*) but in the second syllable there was a sharp drop. This means that unlike Posti, whose discussion of "intonation" remained in the framework of the lexical tone in the first syllable, Kettunen was either unable or unwilling to distinguish between syllable intonation and sentence intonation. Even more intriguing is Kettunen's claim (1937: 314) about there being no other falling intonation in Livonian than the one when stød is absent. Supposedly he had in mind an alternative use of words both (a) with the rising-falling pitch combined with intensive glottalization, and (b) with prevailingly falling pitch combined with weak glottalization. However, Posti (1937b) in an answer to Kettunen (1937) remained convinced that there is a special falling intonation in Livonian.

In the grammatical introduction to his Livonian dictionary (1938), Kettunen included a section on word intonation. He offered a short description of Latvian intonations based on Jānis Endzelīns' grammar

("Lettische Grammatik" in 1922) and accepted German terms used in describing Latvian also for Livonian. The plain tone was called *gedehnte intonation* 'stretched intonation'. The broken tone was *stossintonation* or *bruchintonation*. Kettunen (1938: XXI, 1947: 22) maintained that depending on the person (especially in West Livonian), the *stosslaut* (or *bruchlaut*) and probably also the weakening of the expiratory stress can be totally absent, and by ear only a falling intonation can be perceived, which differs from the stretched intonation by shorter syllable quantity. Kettunen (1938: XXII) noted that the Livonian *bruch* is a replacement of the lost sound, either *h* or the vowel of the second syllable. This grammatical introduction was printed as a separate somewhat supplemented volume in 1947, but the explanations remained quite unchanged. Also later he maintained the stance (1960: 126) that Livonian has a broken sound which is manifested by a very brief stop-like closure in the middle of a voiced sound.

In 1941, Aarni Penttilä and Lauri Posti published their joint paper, where Livonian rising and broken intonation (*die steigende und Stossintonation*) were observed. They presented 56 oscillograms of one Eastern Livonian idiolect (again, the informant was Livonian fisherman Pētõr Folmaņ) and showed the pitch movement in the test words. The research material was divided into two main groups: words pronounced in isolation, and sequences of two or three words. The authors divided the isolated words into five subgroups: (1) cf. *mo̯* 'land', *ro̯gə̂ᴅ* 'brushwood', (2) cf. *jùodə̂* 'drink, Inf', (3) *ma'gdõd* 'sweet (NPl)', (4) cf. *e̯də̂ɢ* 'evening', (5) cf. *nĭemə̂* 'cow, NSg'.

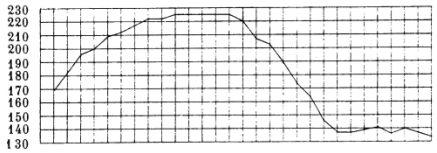

Abb. 1. *kо̯mal.*

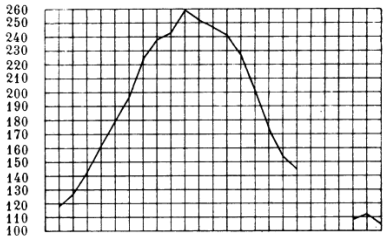

Abb. 22. *rŏ̯gə̂ᴅ.*

Figure 5. **Examples of words** *kо̯mal* 'handful' with rising and *rŏ̯gə̂d* 'harness, NPl' with broken intonation (Posti, Penttilä 1941: 253, 259)

The other main group consisted of word sequences which the authors (1941: 244–245, figures on pp. 261–272) divided into six

groups. The F0 contours of word sequences were compared with the contours of isolated words.

Penttilä and Posti concluded (1941: 252) that the intonation curves of the words with rising and broken intonation were not as regular in sentences as in words pronounced in isolation. The same was true of the words in the so-called utterance-final position (i.e. immediately before the pause) at least in the case of short sentences. The tone contours of words in the so-called mid-sentence position were relatively difficult to determine. This was the case of the so-called word melody, where the sentence intonation was superior to word prosody. This observation led them to conclude that in the case of broken intonation there must be other factors in addition to F0 that play a role. A complete break in voice was not detected in their materials. The main difference between the broken tone and the rising tone according to Penttilä and Posti was that the F0 fall was much longer and 'dominating' in the broken tone than in the rising tone, where the rising phase was much longer (hence the term 'rising intonation').

Fanny de Sivers (1965) maintained that stød in Livonian is not a tone but *le coup de glotte* 'the glottal stop', i.e. a segment. To support this, she shows that there exist counterparts to the Livonian words with stød in Finnish and Estonian: e.g. *raha* 'money'; the consonant *h* has been recognized as one of the sources of the Livonian stød.

Marilyn May Vihman's (1971) doctoral dissertation, which contains an interesting approach to the historical phonology of Livonian, also dealt with the instrumental study of stød in Danish and Livonian. Spectrographic and oscillographic studies of stød in both languages were carried out in the U.S. The dissertation includes an overview of earlier studies on stød in Danish and Livonian followed by Vihman's own experimental results and analyses. Generally, Vihman explained the acoustical essence of Livonian stød as a complex intonation unit. According to her data, occurrence or non-occurrence of broken intonation (stød) was the only regular tonal alternation in Livonian.

In her acoustic measurements, Vihman (1971: 264) tried to find answers to the following questions: (1) Under what circumstances can stød be realized as a complete glottal closure or stop? (2) How much acoustic evidence can be found for the two-phase analysis of stød? In other words, are there any perceptional characteristics for the first phase or do they only exist for the second phase (as hypothesized by Svend Smith)?[9] (3) How similar is the location of stød in syllables

9 Vihman (1971: 250–251) refers to Svend Smith's dissertation (1944), where the Danish stød is characterized as "a particular kind of dynamic accent", consisting of two phases, the first involving "higher tension", the second a decrease in amplitude often accompanied by irregular oscillations.

with a long and short vowel in Livonian and Danish? (4) How similar are the F0 contours (pitch curves) in these two languages in words with and without stød and how are they best characterised? (5) What kind of perceptional cues or features are included? Does the F0 contour function alone or does intensity (amplitude) also have an important role to play? (6) Is it possible to define stød acoustically using the same terminology in Livonian and in Danish?

For her study, Vihman used minimal and near-minimal pairs where one of the words in a pair contains stød and the other one does not. She concluded (1971: 293) that the only structure where stød is manifested as a complete glottal closure is represented by the Livonian short vowel + obstruent forms, where a glottal stop occurred in over 90% of the tokens sampled.

For the two-phase nature of stød (1971: 293–294), Livonian appeared to offer a better model than Danish, though the realization of stød at a particular point in the word was only occasionally discernible in Livonian. Namely, during the first phase of stød, the intensity was higher than in cases without stød, but there were no such differences in the F0.

Vihman (1971: 281) admitted that it is difficult to draw any detailed conclusions about a typical F0 contour occurring in connection with stød, because a sentence intonation tended to be superimposed. Nevertheless, the correlation described by Posti was also apparent in her results. The Livonian stød was often accompanied by a relatively early F0 fall. She noted (1971: 282–284) that the absolute correlation between level intonation and the absence of stød would appear to confirm Posti's suggestion that the overall pitch contour functions as part of the perceptual cue for stød in Livonian. She found the occurrence of a sudden sharp drop in pitch to be relatively rare, instead being replaced by a gradual or a two-step drop. The acoustic realization of the Livonian stød contained irregular vibrations of the vocal folds or glottalization in 41% of the cases (and 57% for Danish).

Vihman emphasized (1971: 284–286) that, in addition to the F0, intensity also played a role in the realization of stød. The intensity of the first vowel in words with stød was greater than in those without stød, whereas in the vowel of the second syllable, the intensity was weaker in words with stød than those without stød. Thus, the intensity curve of the words with stød was more varied and less stable. The double intensity peak found in long vowels in Danish words with stød occurred only occasionally in Livonian, and in fact in Livonian it is in the long vowel forms that stød is most difficult to perceive.

Vihman stressed that the Livonian stød is not realized as clearly in one location as the Danish stød. The Livonian stød became more

apparent from the overall contour of intensity as well as the F0. The forms with a short vowel followed by a medial obstruent clearly showed that stød occurred in such cases within the consonant (1971: 296).

In his phonological analysis, Tiit-Rein Viitso (1981: 27) stated that his treatment of Livonian word intonations is most similar to Posti's phonological approach (Posti 1973). Heavy accent corresponds to rising intonation in Posti's studies, broken accent to Posti's broken intonation, light accent to words which are unmarked by special intonation in Posti's view.

In his study on the quantity of Livonian vowels, Seppo Suhonen (1982) tried to find answers to the following main questions concerning stød: (1) How does stød (*der Stoss*) influence the duration of vowels? (2) Where is the location of stød? (3) What is the duration of stød? Suhonen treated separately: (a) short vowels, (b) long vowels, (c) diphthongs, (d) triphthongs, and (e) diphthongs which have arisen as a result of breaking. Suhonen's data indicated that stød had a tendency to lengthen short vowels and diphthongs which have arisen as a result of breaking but shorten long vowels and diphthongs. Stød seemed to have only a negligible influence on triphthongs (1982: 296). Suhonen observed that both in his and in Kettunen's data, short vowels of the first syllable were lengthened only in disyllabic words, whereas in mono- and trisyllabic words, they shorten. Suhonen (1982: 298) concluded that in tetrasyllabic words, the duration of vowels in both closed and open syllables are the same as in disyllabic words.

Hille Pajupuu and Tiit-Rein Viitso's study on Livonian polyphthongs (1986) discussed the differentiation of polyphthongs with and without stød on the basis of F0, the distinguishing of the quality of diphthongs on the basis of first formants, and durational relations of the component parts of polyphthongs. The analysis showed that (1986: 107): (1) stød was preceded by a sharp F0 rise, and (2) stød was accompanied by a decrease in intensity. Though the second characteristic could sometimes be absent, stød was always characterized by a sharp and extensive F0 rise (and often also with a sharp fall).

Kalevi Wiik (1989) compiled a detailed overview and description of previous studies on Livonian stød. His main interest was the location and the duration of the stød (*katko*). Looking at the studies conducted in the 1920s and 1930s, he is probably the only one who has carried out measurements on the basis of Kettunen's and Posti's kymograms and tried to determine the exact beginning of stød.

On the basis of studies on Livonian and Fischer-Jørgensen's study (1989) on Danish, Wiik (1989: 65–67) carried out a comparison of the Livonian and Danish stød and concluded that: (1) in both languages,

there is plenty of variation between speakers as well as in the speech of one speaker, (2) it is considerably harder to find stød in continuous speech as compared to words produced in isolation; (3) in both languages, stød has a similar F0 and intensity contour: in cases with stød the contour is more varied (steeper initial rise, earlier and slightly higher peak and a lower F0 final) than in forms without stød; (4) the location of stød is almost identical in Livonian and Danish. The influence of stød on long vowels is also similar: in both languages, stød shortens the long vowels in disyllabic words. The influence of stød on short vowels, however, is different: in Livonian, stød lengthens the short vowels, whereas in Danish it shortens them (in Danish it is the following resonant that lengthens a short vowel); (5) the phonetic realization of stød as a glottal stop is a rare occurrence in both languages (in only 0 to 10% of cases); (6) stød is realized in both languages as glottalization. In Danish, the glottalization is slightly more frequent than in Livonian; (7) the duration of stød, in cases where it is possible to measure it, is largely the same in Livonian and Danish, about 30–60 ms.

Unlike several earlier researchers, Paul Kiparsky (2006: 4) pointed out that Livonian stød is a fundamentally tonal phenomenon, a falling (HL) tone. He considered it possible that stød arose due to language contact, i.e. the opposition of word tone which is not typical of Finno-Ugric languages developed through the influence of Latvian, a Baltic language where this is a common feature. However, this could also be (2006: 15) due to the phonemization of a redundant pitch contrast.

An acoustic study on Livonian prosody (Lehiste et al. 2008) showed that the older generation produced the broken tone in words where it was expected. Phonetically, it was manifested as a period of laryngealization. The middle generation differed among themselves and the youngest speakers hardly produced the broken tone at all.

However, the difference between a rising and a falling F0 contour turned out to play a role in contributing to the distinction between words having a long first syllable and either a half-long or a short second syllable. Namely, the words with a half-long second syllable had a rising F0 contour on the first syllable (with a late peak), and the words with a short second syllable had a falling F0 contour (with an early peak). Thus, the F0 contours resemble those found in Estonian long and overlong quantity.

Teras and Tuisk (2009) showed that when speakers have to pronounce words in minimal pairs the words where stød is expected are differentiated from words where stød is not expected first and foremost by laryngealization, and by an early F0 peak followed by a fall in F0. Laryngealization occurred in 87% of the words with stød.

Nevertheless, in Livonian spontaneous speech (Tuisk, Teras 2009), laryngealization in stød words appeared to occur rather rarely. In fact, it was the peak or turning point of the F0 curve that was dominant in differentiating words with and without stød. Disyllabic Q3 words where stød was expected were characterized above all by an early F0 turning point occurring in the first third of the first syllable.

The interaction between pitch alignment and durational changes in three structures of disyllabic words in spontaneous Livonian was analysed (Tuisk 2012). The results (2012: 9–10) indicated that like in Finnish, there seems to be a single overall F0 tune in Livonian, irrespective of word structure, and that segment durations are adjusted in order to reach this uniform tonal goal.

To summarize previous surveys on Livonian tonal characteristics, some observations on the origin of Livonian broken tone or stød will be presented. Kettunen (1938) suggested that Livonian might have provided a model for Latvian. Posti (1942) believed the phenomenon to have arisen quite independently in Livonian and Latvian, apocope, syncope and syllable contraction being the main reasons in Livonian. Unlike Kettunen and Posti, Wiik (1989: 97–105) presented the Syllable Boundary Theory, which is used to give an attempt to describe the formation of Livonian stød as a remnant of a former syllable boundary. Winkler (1999, 2000) strongly argued against the autochthonous nature of the Livonian stød and explained the rise of both Livonian and Leivu South Estonian stød with Latvian influence. Kiparsky (2006: 15) believed Livonian stød to be the influence of Latvian. On this hypothesis one can account for the Livonian stød by language contact, and for the Latvian counterpart as a Baltic inheritance.

6. Foot isochrony

There is one characteristic in Livonian not mentioned yet, and this is a tendency to balance syllable durations to arrive at foot isochrony (Lehiste et al. 2008, Tuisk, Teras 2009). This is a significant feature which is similar to Estonian (Lehiste, Ross 2001). Like in Estonian, a longer first syllable is followed by a shorter second syllable, and vice versa, resulting in approximately equal foot durations. Figure 5 illustrates the tendency to balance syllable durations in order to arrive at foot isochrony.

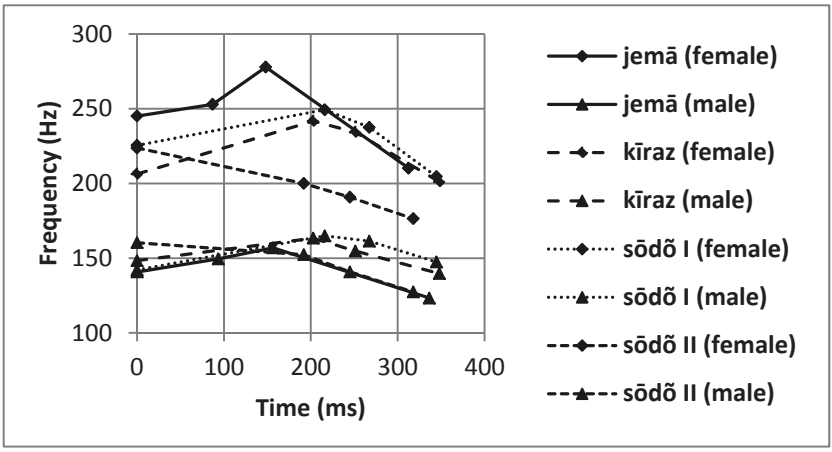

Figure 6. Pitch contours of the three word structures of disyllabic words in spontaneous Livonian (female and male speakers). The four measurement points are taken (1) at the beginning of V1, (2) at the end of V1, (3) at the beginning of V2, and (4) at the end of V2. (Tuisk 2012: 9)

However, in Livonian there is a tendency for the syllable durations in secondary stressed feet to be somewhat shorter than in primary stressed feet (Lehiste et al. 2008: 66–67). Secondary-stressed feet with a short open first syllable and a half-long second syllable vowel have a shorter duration than primary-stressed feet with the same structure. In secondary-stressed feet, too, the second syllable vowel is longer than the first syllable vowel (duration ratios V1/V2 = 0.5, V3/V4 = 0.8). At the same time, vowels in secondary-stressed feet are much shorter than in primary-stressed feet. For that reason, there is a difference in foot durations. Secondary-stressed feet containing a geminate consonant also have shorter durations than primary-stressed feet of the same structure.

7. Summary

The survey of previous studies of the Livonian prosodic system reveals a certain degree of agreement among the researchers. Similar prosodic features found in Estonian, Latvian, Danish and other languages have been described. Comparable aspects with Estonian become evident more than once. With regard to the number of contrastive quantities in Livonian, the traditional two-way quantity

opposition view is being challenged by a ternary quantity distinction at the level of metric feet.

As far as quantity is concerned, an opposition between short and long phonemes is always observed in Livonian. The opposition of short and long durations is evident in stressed syllables. Livonian also differentiates between single consonants, short geminates, and long geminates, but the three-way opposition is manifested only on the boundary of a stressed and unstressed syllable. Both vowel length and consonantal length alternations are distinguished. The occurrence of a half-long vowel, similar to Estonian, is observed in the second (unstressed) syllable.

However, the opposition between metric feet in Livonian and Estonian is achieved by different means. In Estonian there is a three-way opposition both in the duration of stressed vowels and the structure of metric feet. In Livonian, there is a three-way opposition between metric feet, but a two-way opposition at the level of vowels and syllables.

The question of tonal oppositions has received a great deal of attention. The main focus of the discussion is broken tone or stød. An intriguing aspect has been the question of the segmental nature of stød, while the prosodic function has been paid less attention. In Livonian, the term that is used in older descriptions is German *Stosston*, while in newer descriptions the phenomenon is referred to as broken tone or stød tone. There are extensive discussions of the phonetic manifestation of the broken tone and the glottal modification also found in Danish. Another debate has been on the question of the syllable nuclei that do not carry the broken tone.

In terms of acoustics, it is reasonably easy to characterize stød by means of the F0 and intensity. There are attempts to analyse 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. The concept of syllable weight is observed as well. Despite the question of terminology, there seems to be an agreement in the opposition of the presence and absence of this phenomenon.

Acknowledgements

This study was supported by the project IUT2-37 financed by the Estonian Ministry of Education and Science. The author is very grateful to Eva Liina Asu-Garcia and David Ogren for editing the language of this paper.

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Kokkuvõte. Tuuli Tuisk: Ülevaade liivi prosoodia uurimustest. Käesolevas artiklis antakse ülevaade uurimustest, mis käsitlevad liivi keele prosoodilist süsteemi. Liivi keele prosoodia äratas esmakordselt rahvusvahelist tähelepanu 19. sajandil. Eesti keeleteadlane Ferdinand Johann Wiedemann ja taani keeleteadlane Wilhelm Thomsen olid esimesed, kes märkasid liivi toonide iseärasusi. Huvist liivi katketooni vastu hakati 1920. aastatel tegema

ka esimesi eksperimentaal-foneetilisi uurimusi. Ehkki varasemad uurimused peegeldavad teadlaste üsna üksmeelseid seisukohti, on liivi binaarse kvantiteedivastanduse kõrval aina enam arutelu tekitanud ternaarne kvantiteedivastandus.

Märksõnad: liivi keel, prosoodia, fonoloogia, eksperimentaalfoneetika, kvantiteet, toon, stød

Kubbõvõttõks. Tuuli Tuisk: Iļļõvaņtļimi iļ līvõ prosodij tuņšlõkst. Se kēra um iļļõvaņtļimi iļ tuņšlõkst līvõ kīel prosōdij sistēmõst. Līvõ kīel prosōdij sai ežmõks tā̆dõlpanmizt 19. āigastsadā āigal. Ēsti kēļnikā Ferdinand Johann Wiedemann ja dēņõ kēļnikā Wilhelm Thomsen vȯļtõ ežmizt, kis kāipizt ku līvõ kīelsõ at īžkizt tūoņõd. Ežmizt fonētilizt kōļimizt teitõ 1920. āigastis, sīepierāst ku interesīerizt iļ līvõ katkāndõks agā murdtõd tūoņ. Jedlõmizt tuņšlõkst nägţõbõd, ku tieudmīed vȯļţõ dižānist īdmēļizt, agā līvõ kõdvīţi pitkit vastõmtõks kūorõks um emīņ nõvtõd iļ kuolmvīţiz pitkit vastõmtõks.