

BROKEN TONE IN LEIVU CV'V-WORDS

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Abstract. Leivu is one of the South Estonian dialects historically spoken in eastern Latvia and influenced by Latvian. One likely influence is broken tone or *stød*, which was developing in Leivu mainly as a result of the loss of /h/ in first quantity degree words. The aim of this study is to determine what characterises the pronunciation of CV'V-words (lost intervocalic /h/) and differentiates these from CVV-words. Sound durations, F0 and intensity contours of the syllable rhyme were analysed. Vowel duration in CV'V-words tends to be longer than in CVV-words. In CV'V-words, a short drop in intensity can occur between two identical or two different vowels, with the first vowel often being longer than the second one. In some cases, the second vowel in CV'V words was laryngealised. In CV'V-words, an early F0 turning point where F0 starts to fall occurs more consistently than in CVV-words where F0 can also be rising.

Keywords: word prosody, broken tone, South Estonian, linguistic enclaves, Leivu

DOI: <https://doi.org/10.12697/jeful.2021.12.2.07>

1. Introduction

The South Estonian Leivu dialect was historically spoken in eastern Latvia. Valter Niilus (1935: 369) identifies six parishes where Leivu speakers once lived: Ilnä (Ilzene), Alamõiza (Lejasciems), Mäemõiza (Kalncempji), Seltnä (Zeltņi), Alsviki (Alsviķi), and Duure (Dūre) parish. During his fieldwork in 1935, he met 55 speakers in Ilnä (Ilzene) parish who spoke Leivu to varying degrees. According to him, there were a total of 131 speakers of Leivu in this parish at that time. Additionally, there were also some Leivu speakers living in a few other parishes. (Niilus 1935: 370) During subsequent years, Leivu speakers were assimilated into the Latvians. The last tape recordings of Leivu speakers were made in the 1980s, and Anton Boks, who died in 1988, is known to have been the last speaker of Leivu (Nigol 1988).

Phonetic transcriptions of Leivu (e.g., Niilus 1937, Mets et al. 2014) show that first quantity (Q1) words as well as second quantity (Q2) words with consonant clusters where /h/ occurs in other Estonian dialects were often pronounced without /h/. However, some cases where an intervocalic /h/ has not been lost have also been found (e.g., *rahaga* ‘money, SG.COM’, for examples see Balodis, Pajusalu & Teras 2016: 104–105). The loss of an intervocalic short /h/ has often been marked with an apostrophe in transcriptions, e.g., *taha* > *ta'a*¹ ‘want, PRS.1SG’, *vahetama* > *va'ëttama* ‘to exchange’ (Niilus 1936), *naha* > *nã'a* ‘nahk, SG.GEN’, *raha* > *rã'a* ‘money, SG.GEN’, *pähe* > *pã'ä* ‘head, SG.ILL’ (Niilus 1937), but sometimes no apostrophe has been used and in such cases the transcription resembles that of third quantity degree (Q3) words, e.g., *raha* > *rã* ‘money, SG.GEN’, *rãd* ‘money, SG.PRT’, *liha* > *l'iãd* ‘meat, SG.PRT’ (Niilus 1937) (cf. *mã* ‘land’, *mãd* ‘land, SG.PRT’).

Valter Niilus (1936: 37–38) has pointed out that transcriptions of Leivu from the 19th century by Anders Johan Sjögren and Ferdinand Johann Wiedemann show that /h/ was pronounced at that time, but that transcriptions from the 1920s by Paulopriit Voolaine show variation. His own observations from the 1930s show that variants without /h/ prevail. According to Niilus (1936: 38), in some cases a glottal stop or a pause occurs between vowels instead of /h/ or, in certain word types², the approximant [j], e.g., *tãht*: *tãhe* > *tãijè* ‘star, SG.GEN’, *jahe* > *jaijè* ‘chilly’. Tiit-Rein Viitso (2009: 277–278) analyses in detail different Leivu word structures where intervocalic /h/ has been lost or replaced by /j/. He proposes (2009: 278) that /h/ was “substituted with stød mostly in illative forms of monosyllabic vocalic stems and in stems where *h occurred between identical vowels”.

Broken tone or stød is one of the innovations that the South Estonian Leivu dialect shares with another Finnic language – Livonian (Viitso 2009). The loss of /h/ has also been regarded as one reason for the development of broken tone in Livonian (e.g., *rõ' ~ rõ'õ' ~ rõ'õ'*)

1 I use the transcription that the original authors used in the examples I provide. In most cases this is Uralic Transcription, where a breve above a vowel marks a half-short vowel, a grave marks a half-long vowel, a macron marks a full-long vowel, and a circumflex marks an overlong vowel. In Section 3, I use the International Phonetic Alphabet (IPA).

2 In these words, there tend to be *a*, *o*, *ã* in the first syllable and *e* or *ë* in the second syllable, but there are also other word types (see Niilus 1936: 38). In Uralic Transcription, [e] marks retracted [e].

(Est *raha*) ‘money’, *tu’ont* (Est *tuhast*) ‘thousand’, *mi’ed* (Est *mehed*) ‘men’) (Kettunen 1938: XXXV, see also Viitso 2009: 278). Kettunen (1938: XXXVI) proposes that in such words, /h/ became voiced and was assimilated into the preceding vowel, which, in these long syllables, was pronounced with a sharply falling tone that developed into the broken tone. With respect to Leivu, Niilus (1936: 40) refers to language contact with Latvian as one reason for the loss of word-initial and intervocalic /h/ (there is no /h/ in Latvian) and draws a parallel with Livonian. Although Viitso (2009: 278) finds that the loss of intervocalic /h/ resulted in broken tone in Leivu when there were two identical vowels, some examples can be found in transcriptions of Leivu where the syllable boundary or broken tone is also marked in the case of nonidentical vowels, e.g., *vahetama* > *va’ęttama* ‘to exchange’ (Niilus 1936: 39), *rehi* > *re,ì* ‘threshing house’, *tuhast* > *tu,ast* ‘ash, SG.TRL’ (Mets et al. 2014: 58, 62), *reha* > *re’a* ‘rake’ (Vaba 1997: 47).

According to Viitso (2009: 278), broken tone or *stød* is the “modulation of a sonorous segment, which is produced by means of an additional effort of vocal cords”; this modulation is usually realised as a drop or even a break in fundamental frequency or intensity, but in emphatic speech also as a glottal stop. Broken tone or *stød* is characteristic of several languages spoken around the Baltic Sea. These include Finnic languages – Livonian (Lehiste et al. 2008, Tuisk 2015) and, in addition to the South Estonian Leivu dialect, also the South Estonian Lutsi dialect (Balodis, Pajusalu & Teras 2016) – as well as Indo-European languages – Latvian (Kariņš 1996: 16, Bond, Markus & Stockmal 2016: 3), Lithuanian (Balode & Holvoet 2001), Danish (Fischer-Jørgensen 1989, Grønnum 2015).

While some preliminary observations about the acoustic phonetic characteristics of broken tone have been made for the South Estonian Leivu and Lutsi dialects, several acoustic characteristics of broken tone have been determined in other languages. These characteristics will be discussed next, beginning with the Indo-European languages and then moving on to the Finnic languages with a focus on Livonian.

In Standard Latvian, long syllables have three contrastive tones: level, falling, and broken tone (Kariņš 1996: 16). The domain of broken tone is the voiced syllable rhyme of long syllables (Lehiste 1969: 144). Compared to level tone words, Latvian broken tone words are characterised by shorter vowel duration and a falling F0 contour in the stressed

syllable (in level tone words F0 is rising or level) (Kariņš 1996: 23, 130, Bond, Markus & Stockmal 2016: 7–8), and a short glottal stop in the middle of the syllable rhyme (Lehiste 1969: 149) or laryngealisation in the latter part of the syllable rhyme (Lehiste 1969: 148–149, Kariņš 1996: 23, 131) – or more rarely, during the entire syllable rhyme (Lehiste 1969: 149, Bond, Markus & Stockmal 2016: 8 – for only one elderly speaker, but not other speakers). In certain Latvian dialects that have differentiated broken, falling, and level tone, broken and falling tone have started to merge (Bond, Markus & Stockmal 2016: 3).

In Standard Lithuanian, long syllables have acute or sharp or falling tone, and circumflex or drawn or rising tone (Balode & Holvoet 2001: 50). However, most Žemaitian dialects spoken in northwestern Lithuania also have broken tone. There it is characterised by a rise in F0 and intensity at the beginning of the syllable rhyme, followed by glottal stop or laryngealisation and a sudden fall in F0 and intensity (in circumflex or level tone syllables no such fall occurs) (Balode & Holvoet 2001: 73).

In Danish, there is a contrast between words with and without *stød* (cf. Fischer-Jørgensen 1989, Grønnum 2015). In Danish, like in Latvian, the domain of *stød* is a long vowel or a short vowel followed by a sonorant in certain word structures (Grønnum & Basbøll 2002: 85). Compared to words without *stød*, Danish words with *stød* have higher F0 at the beginning of the syllable rhyme (Fischer-Jørgensen 1989, Grønnum 2015), which is also accompanied by higher intensity (Fischer-Jørgensen 1989). There is also a decrease in F0 and intensity in the latter part of the syllable as well as laryngealisation (Fischer-Jørgensen 1989). The main characteristic of *stød*, however, is laryngealisation or creaky voice. The timing of laryngealisation is variable (Grønnum 2014). Ilse Lehiste (1969: 152), for example, found that syllables where a vowel is followed by a sonorant are characterised by laryngealisation during the sonorant, more rarely between the vowel and sonorant or during the entire syllable rhyme. In Danish, duration appears not to distinguish words with and without *stød* as consistently as in Latvian or Livonian: for example, long vowels in words with *stød* are often longer, but sometimes also shorter than words without *stød* (Fischer-Jørgensen 1989: 48) – or they do not differ in duration (Grønnum & Basbøll 2002: 86).

In Livonian, as in Latvian and Danish, the domain of broken tone is the voiced syllable rhyme of the long syllable (Tuisk 2015: 25, Kiparsky

2017: 195). Livonian broken tone words, when compared to words without broken tone, have the following characteristics: a shorter duration of long vowels, irregularity in the intensity contour and a sudden intensity drop in the syllable rhyme, a laryngealisation phase that occurs more often in read than in spontaneous speech (Tuisk 2015: 32, 33). The location and duration of the laryngealisation phase varies but most likely starts at the end of the first third or in the middle of the syllable rhyme (Tuisk 2015: 33). The most stable feature of Livonian broken tone is an early F0 turning point where F0 starts to fall (Tuisk 2015: 33).

As noted above, there exist earlier acoustic phonetic studies of Leivu quantity (cf. Teras 2010, 2011) as well as some preliminary observations about the characteristics of broken tone in Lutsi South Estonian, which was also spoken in Latvia (cf. Balodis, Pajusalu & Teras 2016), and in Leivu South Estonian (cf. Teras 2010: 9, 2011: 168, Balodis, Pajusalu & Teras 2016). Preliminary observations about the acoustic characteristics of Leivu and also Lutsi broken tone words showed that words where an intervocalic /h/ has been lost are “characterised by falling F0, an abrupt dip in intensity movement during the vowel, and secondarily by a laryngealisation period during or at the end of the vowel” (Balodis, Pajusalu & Teras 2016: 112). However, a more in-depth acoustic phonetic analysis of broken tone words has not yet been done. It is not yet clear how consistent the loss of short intervocalic /h/ is or what the main acoustic characteristics of Leivu broken tone words are. This article focuses on analysing Leivu disyllabic words where loss of /h/ occurs. These words, referred to as CV’V-words in this study, will be treated as monosyllabic and compared to monosyllabic third quantity degree (Q3) CVV-words. The aim of this study is to determine the acoustic characteristics of Leivu CV’V-words. The questions addressed in this study are as follows:

- 1) how consistent is the loss of intervocalic /h/ in Leivu Q1 words;
- 2) what acoustically characterises broken tone in Leivu CV’V-words;
- 3) what differentiates CV’V-words from CVV-words.

2. Materials and methods

Digitised tape recordings of Leivu are available at the University of Tartu Archives of Estonian Dialects and Kindred Languages³ and at the Institute of the Estonian Language Archive of Estonian Dialects and Finno-Ugric Languages.⁴ The material for the current study was gathered from the spontaneous speech of three male speakers of Leivu:

- 1) **Peter Melec (PM)** was born in 1867 and recorded in 1956 in Soosaare (Sūzaŗi) village, Ilnä (Ilzene) parish in Latvia (recordings EMH0003-01, EMH0003-02, EMH0004-01, EMH0004-02 (total duration 1 h 12 min) from the Institute of the Estonian Language Archive of Estonian Dialects and Finno-Ugric Languages);
- 2) **Artur Peterson (AP)** was born in 1901 and recorded in 1971 in Paikna (Paiķēni) village, Ilnä (Ilzene) parish in Latvia (recordings F0158-01, F0158-02, F0158-03, F0158-04 (total duration 32 min) from the University of Tartu Archives of Estonian Dialects and Kindred Languages);
- 3) **Anton Boks (AB)** was born in 1906 and recorded in 1971 in Pajušilla (Kārklupe) village, Lejasciems parish in Latvia (recordings F0158-01, F0158-02, F0158-03, F0158-04 (total duration 29 min) from the University of Tartu Archives of Estonian Dialects and Kindred Languages).

In this paper, disyllabic CVhV(C)-words where loss of intervocalic /h/ occurs resulting in a CV'V(C)-word are examined (e.g., *raha* > *ra'a* 'money', *tahad* > *ta'ad* 'want, PRS.2SG', *tuhast* > *tu'ast* 'ash, SG.TRL') and compared to monosyllabic CVV(C)-words (e.g., *maa* 'land, earth', *sour* 'big', *kiilt* 'language, SG.PRT'). Content words were chosen for analysis, because less reduction is expected there. In the following analysis, these groups are called CV'V-words and CVV-words.

As there are no living Leivu speakers left, no additional material can be recorded. This is the reason that the material used in this study is limited to that which is available. The limited nature of the material is also one of the disadvantages of spontaneous speech. There were

3 <https://murdearhiiv.ut.ee/index.php>

4 <http://emsuka.eki.ee/>

a total of 24 CV'V-words where intervocalic /h/ was not pronounced and 202 monosyllabic CVV-words (see Table 1). The second syllable of the CV'V-words was open or closed (16 and 8 words, respectively), and the monosyllabic CVV-words also consisted of an open or closed syllable (74 and 128 words, respectively). Additionally, there were only a few cases of /h/-words where /h/ was retained and pronounced as voiced: Speaker PM had 2 such cases out of 16 /h/-words (*ahas* [awas:] 'narrow' and *tahat* [taħat:] 'want, PRS.2SG') and Speaker AB had 4 such cases out of 10 /h/-words (all of them *raha* [raħa] 'money').

Table 1. The number of analysed CV'V- and CVV-words by speaker and syllable type.

Speaker	CV'V-words		CVV-words		CV'V-words	CVV-words
	Open syllable	Closed syllable	Open syllable	Closed syllable		
PM	9	5	31	66	14	97
AP	2	2	6	45	4	51
AB	5	1	37	17	6	54
All	16	8	74	128	24	202

The words were acoustically analysed with the phonetic analysis program Praat (Boersma & Weenink 2021):

- 1) the durations of all sounds were measured in milliseconds; diphthongs were segmented into two components dividing the transition from the first component to the second component between the two vowels. In words where /h/ was lost between two identical vowels, a short drop in intensity (in the intensity curve or the sound wave) occurred. The valley of this drop was marked as a boundary between the two vowels;
- 2) fundamental frequency (F0) and intensity values were measured from the beginning and end of the voiced part of the syllable rhyme and from the turning point (TP) where F0 or intensity started to decrease (see an example of segmentation and annotation in Figure 1). The location of the TP was estimated visually.

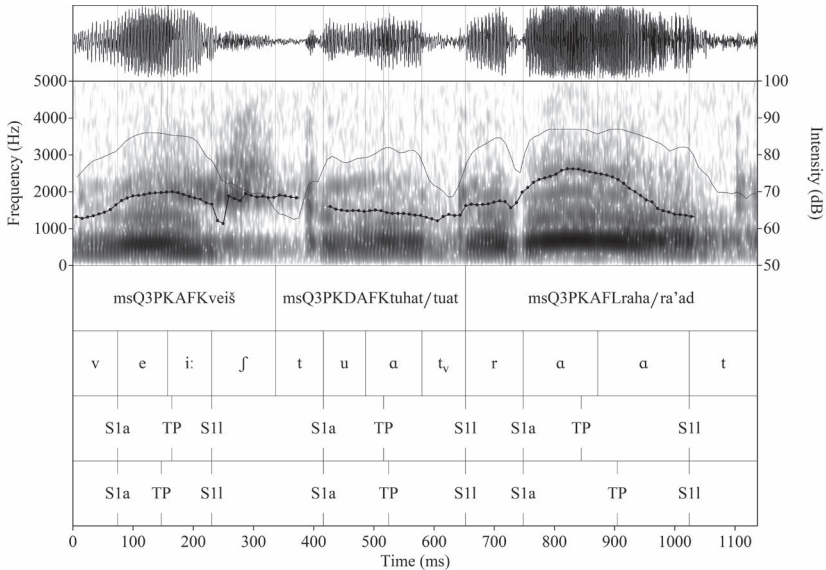


Figure 1. An example of segmentation and annotation of the phrase *veiš tuad ra'ad* 'five thousand of/in money'. Sound wave, spectrogram, intensity contour (solid line), F0 contour (dotted line, scale 80–350 Hz). The annotation shows four tiers: words, sounds, F0 and intensity measurement points (S1a, S1l – the beginning and the end of the syllable, TP – turning point).

The data were gathered using Praat scripts (compiled by Pärtel Lippus and modified by the author). The location of the turning point in the F0 and intensity curve was calculated as a percent of the total duration of the syllable rhyme, duration ratios of vowels were also calculated. Words with an open or closed syllable will be analysed separately.

Statistical analysis was carried out in R (R Core Team 2017). Descriptive statistics included the number of occurrences, cross tables to analyse together linguistic factors (syllable type: open or closed, length of syllable-final consonant or consonant cluster: short or long). In order to identify significant differences, one-way and two-way ANOVA and a Tukey post-hoc test were used. The following dependent variables were tested: the total duration of the syllable nucleus (V); F0 values at the beginning, at the TP, and end of the voiced part of the syllable rhyme in accented words with an early TP. The average value of these acoustic measures was calculated for each speaker for the following

factor conditions: for duration and F0 word type (CV'V or CVV), for duration and syllable type (open or closed) as well as C2 type (no consonant, short or long consonant).

3. Results

3.1. Duration

There were only some words where intervocalic /h/ was pronounced. These words are in Q1 where in Standard Estonian the second syllable short vowel is usually pronounced longer than the first syllable short vowel – duration ratio: 0.8 (Lippus et al. 2013: 21, 26). However, in Leivu, variation in duration ratios has been found (ratio: 0.8–1.5, cf. Teras 2010: 4–5). Also, /h/-words showed this variation: in 3 tokens the ratio was 0.32–0.85 (V2 longer than V1 as in Standard Estonian Q1 words), but in the other 3 tokens, the ratio was 1.29–2.24, which resembles that of Standard Estonian Q2 words with a long vowel in the first syllable and a short vowel in the second syllable (duration ratio: 1.8–2.3, Lippus et al. 2013: 21, 26).

In other cases, intervocalic /h/ was lost. Table 2 summarises the results and shows the total duration of vowels and syllable-final consonants by syllable type (open or closed) in Leivu CV'V- and CVV-words. The table shows average durations of syllable nuclei (V, long monophthong or diphthong) and – for closed syllables – consonant durations (ending in a short consonant (short C) or a long consonant or consonant cluster (long C)) as well as standard deviations.

Table 2. Average total duration of syllable nuclei, syllable-final short and long consonants, and standard deviations (in ms) in open and closed syllables of CV'V- and CVV-words (N – number of tokens, V – syllable nucleus).

Word type	N	Open	N	Closed		N	Closed	
		V		V	Short C		V	Long C
CV'V-words	16	294	6	255	83	2	319	242
		45		61	22		15	16
CVV-words	74	279	83	242	92	45	161	192
		77		66	34		48	63

The average duration of syllable nuclei in open syllables is somewhat longer in CV'V-words than in CVV-words (294 ms vs. 279 ms). The same is true for the average duration of syllable nuclei in closed syllables (255 ms vs. 242 ms before short consonants, and 319 ms vs. 161 ms before long consonants or consonant clusters). In CVV-words, vowel duration in closed syllables is shorter before long consonants or consonant clusters than before short consonants (161 ms vs. 242 ms). There were only a few tokens where intervocalic /h/ was lost in words ending in a short consonant (e.g., *raha* > *ra'ad* 'money, SG.PRT', *tühüq* > *tü'üq* 'work, SG.ILL', *tuhat* > *tuad* 'thousand') or consonant cluster (*mihist* > *mi'ist* 'man, PL.ELA', *tuhast* > *tu'ast* 'ash, SG.TRL'). These words do not show the same vowel shortening seen in CVV-words: vowel duration is 255 ms before short consonants and 319 ms before long consonants.

The two-way ANOVA showed no statistically significant difference in the average vowel duration of speakers by word type ($F(df=1, 8) = 2.96, p = 0.12$), but it did show a significant difference by syllable type ($F(df=1, 8) = 8.93, p < 0.05$), and also that there was no interaction ($F(df=1, 8) = 4.12, p = 0.08$). The Tukey post-hoc test revealed that vowel duration in CVV-words is on average shorter than in CV'V-words (29 ms), but that this difference is not statistically significant ($p > 0.05$). It also showed that vowel duration in closed syllables is also on average shorter than in open syllables (50 ms), and that this difference is statistically significant ($p < 0.05$).

The two-way ANOVA showed a statistically significant difference in average vowel duration of speakers by word type ($F(df=1, 11) = 19.86, p < 0.0001$) as well as by C2 type ($F(df=2, 11) = 8.27, p < 0.001$), and that there was an interaction ($F(df=2, 11) = 15.43, p < 0.0001$). The Tukey post-hoc test revealed that vowel duration in CVV-words is on average shorter than in CV'V-words (51 ms), and that this difference is statistically significant ($p < 0.05$). It also revealed that vowel duration before short and also long consonants is on average shorter than in open syllables (44 and 54 ms, respectively), and that these differences are statistically significant ($p < 0.05$). It also showed that vowel duration is on average shorter before long consonants than before short consonants (10 ms), but that this difference is not statistically significant ($p > 0.05$).

Long monophthongs and diphthongs occurred as syllable nuclei. Average durations of syllable nuclei are analysed separately next; average duration ratios of V1 and V2 have also been calculated (see Table 3).

Table 3. Average duration (in ms) of monophthongs and diphthongs in open and closed syllables and duration ratios of vowels (N – number of CV'V-words/CVV-words, V – total duration of syllable nucleus, V1 longer – the first component is longer, V1 shorter – the first component is shorter).

Syllable type	N	V	CV'V-words			V1/ V2	CVV-words			V1/ V2
			V	V1	V2	V	V1	V2		
Open	3/54	Monophthong	268				272			
	10/7	V1 longer	290	176	114	1.56	313	208	105	2.11
	3/13	V1 shorter	331	126	205	0.63	290	113	178	0.65
Closed	0/56	Monophthong		–			186			
	4/29	V1 longer	262	159	103	1.55	250	139	112	1.26
	4/43	V1 shorter	280	116	164	0.73	224	100	124	0.81

In open syllables, the duration of long monophthongs in CV'V-words and in CVV-words is similar (268 ms and 272 ms). However, there were only 3 tokens where the result of the loss of /h/ was a long monophthong: *raha* > *raa* [ra:] 'money', *ei taha* > *ei taa* [ta:] 'want, 3SG.NEG', *tühüq* > *tüü* [ty:]. In closed syllables, long monophthongs occurred only in CVV-words and were shorter in duration than in open syllables (186 ms vs. 272 ms).

When /h/ was lost between two identical vowels, in most cases there was a break between vowels marked by a short drop and rise or a sudden drop in intensity that divided a long vowel into two parts (see Figure 2): in 12 tokens the first part (V1) was longer than the second part (V2) (e.g., *raha* > *ra'a* [ra:⁵a]⁵ 'money', *mihist* > *mi'ist* [mi:⁵ist] 'man, PL.ELA'), and in 2 tokens V1 was shorter than V2 (e.g., *raha* > *ra'ad* [ra:⁵a't], *tühüq* > *tü'üq* [ty:⁵y'q]). In Table 3, all these words have

5 In the examples transcribed using IPA (International Phonetic Alphabet), I use a superscript glottal stop to mark broken tone. Glottal stop has also been used to mark broken tone or stød in Danish and Livonian.

been counted as words containing diphthongs where the first component (V1) was also longer or shorter than the second component (V2).

When an intervocalic /h/ was lost between two different vowels, there were three different outcomes: in 2 tokens, V1 was longer than V2 divided by a break, i.e., a drop in intensity (*rehi* > *re'i* [re^ːi] ‘order, time, SG.GEN’, *d’o’a* [d^ːo^ːa] ‘flour’); in 1 token, V1 was shorter than V2 divided by a break, i.e., a drop in intensity (e.g., *tuhast* > *tu’ast* [tu^ːa:st]); and in 4 tokens, the two vowels were pronounced as a diphthong (V1 shorter than V2, *liha* > *lia* [lia:] ‘meat’, *tuhat* > *tuad* [tua:t] ‘thousand’, *mehe²* > *mie* [mie:] ‘man, PL.NOM’). In 7 tokens, where an intervocalic /h/ was lost, the second part of syllable nucleus was laryngealised.

In words where V1 is longer than V2 and the syllable is open, the total vowel durations in CVV-words are a little longer than in CV’V-words, in other cases the opposite situation is found (see Table 3). Both in CV’V- and CVV-words, vowels in open syllables are longer in duration than in closed syllables (see Table 3). Among CV’V-words, V1 is longer than V2 in 67% of tokens (open syllables: vowel duration ratio 1.56; closed syllables: 1.55) and V1 is shorter than V2 in 33% of tokens (open syllables: vowel duration ratio 0.63; closed syllables: 0.73). Among CVV-words containing diphthongs, V1 is longer than V2 in 39% of tokens (open syllables: vowel duration ratio 2.11; closed syllables: 1.26) and V1 is shorter than V2 in 61% of tokens (open syllables: vowel duration ratio 0.65; closed syllables: 0.81). In CV’V-words there is a tendency for V1 to be longer than V2 and in CVV-words for V2 to be longer than V1.

Figure 2 shows an example of a CV’V-word *raha* > *ra’a* ‘money’ where /h/ is lost and two vowels are pronounced with a break (V1 is longer than V2), i.e., this is an example of broken tone. A drop in the wave form (above) and also in the intensity curve can be seen in this word. Figure 3 shows an example of a CVV-word *maad* (long monophthong) ‘land, earth, SG.PRT’ for comparison.

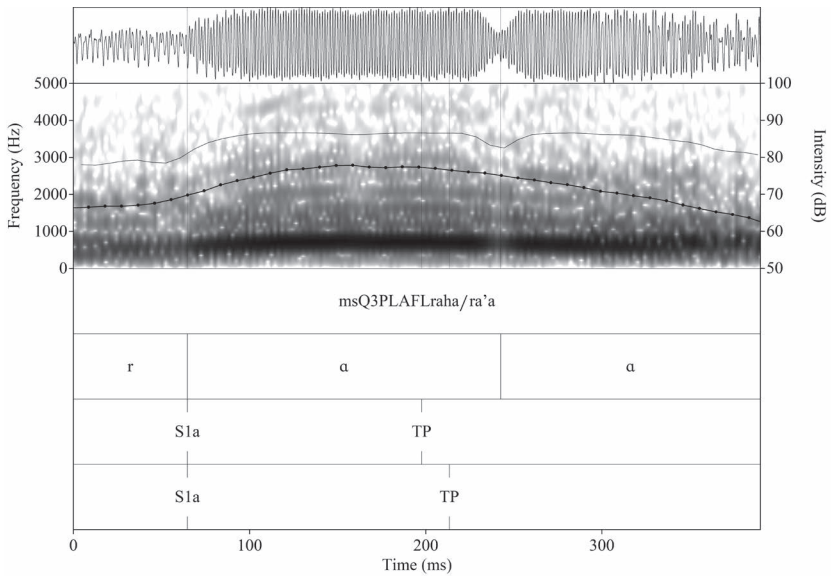


Figure 2. An example of a CV'V-word: *raha* [raːʔa] ‘money’ (Speaker PM, EMH0004-01). Sound wave, spectrogram, intensity contour (solid line), F0 contour (dotted line, scale 80–350 Hz).

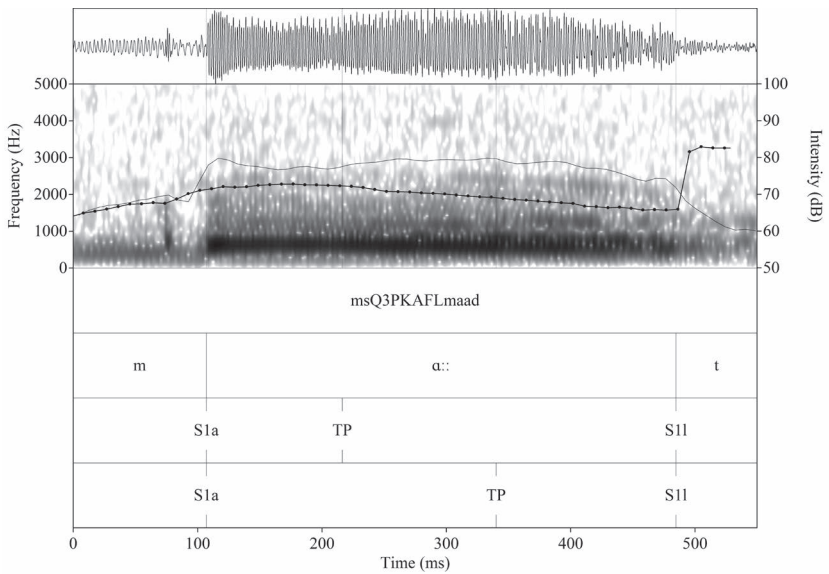


Figure 3. An example of a monosyllabic CVV-word: *maad* [maːt] ‘land, earth, SG.PRT’ (Speaker PM, EMH0003-02). Sound wave, spectrogram, intensity contour (solid line), F0 contour (dotted line, scale 80–350 Hz).

3.2. Fundamental frequency

To analyse the F0 contour, deaccented and accented words were analysed separately. Quantity analyses of Estonian have shown that F0 contours characteristic of Q2 and Q3 words are neutralised in deaccented words (Lippus et al. 2013: 21). The materials used in the current study include 3 deaccented and 21 accented CV'V-words, and 59 deaccented and 143 accented CVV-words. F0 was measured at the beginning and end of the voiced part of the syllable rhyme and at the TP where F0 turned and began to fall. The location of the TP was calculated as a percent of the total duration of the syllable rhyme. Words where the TP occurred in the first half of the syllable rhyme ($\leq 50\%$) are analysed separately from words where it occurred in the second half of the syllable rhyme ($> 50\%$). The following analysis concentrates primarily on accented words, but a short overview of F0 contours in deaccented words is given first.

All deaccented CV'V-words were pronounced with an early F0 TP occurring at 24% of the total duration of the syllable rhyme. From the beginning to the TP, the F0 contour was rather flat (average values: 169 and 166 Hz) followed by slight fall to 150 Hz. Deaccented CVV-words mainly (49 tokens from 59) also had a flat F0 contour from the beginning (155 Hz) to the TP (155 Hz at 24%) followed by a slight fall to 135 Hz. There were fewer deaccented CVV-words (10) where the F0 contour was slightly rising (169 Hz at the beginning, 177 Hz at the TP occurring at 70%, and 175 Hz at the end).

Table 4 shows F0 values (in Hz) at the beginning and end of the voiced part of the syllable rhyme and at the turning point (TP) in accented CV'V- and CVV-words.

Accented CV'V-words tend to have an early F0 turning point (at 23% of the total duration of the syllable rhyme). A late TP occurred only in one phrase-medial word (at 62%). An early TP is also characteristic of CVV-words occurring at 27% of the total duration of the syllable rhyme. However, in 27 CVV-words, the TP was late (72% of the total duration of the syllable rhyme). Half of these words occurred in a phrase-medial position (14 words). It can be concluded that in accented CV'V-words, an early F0 TP occurs more consistently than in CVV-words where it can also occur later (most probably in phrase-medial position).

Table 4. Average F0 values and standard deviations (in Hz) at the beginning and end of the voiced part of the syllable rhyme (S1b, S1e) and at the turning point (TP), and the location of the turning point (%) in accented CV'V- and CVV-words where the TP was early or late.

Words where the TP occurs in the first half of the syllable (an early TP)					
Word type	N	S1b	TP	%	S1e
CV'V-words	20	194	210	23	154
		38	36	13	44
CVV-words	116	186	198	27	156
		35	38	12	44
Words where the TP occurs in the second half of the syllable (a late TP)					
Word type	N	S1b	TP	%	S1e
CV'V-words	1	147	200	62	165
CVV-words	27	163	199	72	182
		25	27	13	28

In words with an early TP, there is a tendency for F0 at the beginning of the syllable and at the TP to be higher in CV'V-words than in CVV-words (S1b 194 Hz vs. 186 Hz, and TP 210 Hz vs. 198 Hz). CV'V-words also show on average a greater decrease in F0 from the TP to the end of the word than in CVV-words (56 Hz vs. 42 Hz). However, the one-way ANOVA showed that these differences are not statistically significant (the results are, respectively, $F(df=1, 4) = 0.29, p > 0.05$; $F(df=1, 4) = 0.16, p > 0.05$; $F(df=1, 4) = 0.67, p > 0.05$).

3.3. Intensity

For intensity, deaccented and accented words were analysed separately. As was done for F0, the location of the intensity TP was also calculated as a percent of the total duration of the syllable rhyme. Words where the TP occurred in the first half of the syllable rhyme ($\leq 50\%$) are counted as having an early TP, and words where it occurred in the second half of the syllable rhyme ($> 50\%$) are counted as having a late TP. Deaccented words (both CV'V- and CVV-words) most often had an early intensity TP.

Table 5 shows intensity values at the beginning and end of the voiced part of the syllable rhyme and at the TP. Intensity is also analysed more closely in accented words. Words with an early and late TP are analysed separately.

Table 5. Average intensity values and standard deviations (in dB) at the beginning and end of the voiced part of the syllable rhyme (S1b, S1e) and at the turning point (TP), and the location of the turning point (%) in CV'V- and CVV-words where the TP was early or late.

Words where the TP occurs in the first half of the syllable (an early TP)					
Word type	N	S1b	TP	%	S1e
CV'V-words	15	78	83	32	74
		5	2	12	5
CVV-words	90	76	82	32	71
		5	4	13	6
Words where the TP occurs in the second half of the syllable (a late TP)					
Word type	N	S1b	TP	%	S1e
CV'V-words	6	76	80	65	73
		4	5	18	5
CVV-words	53	75	83	66	75
		5	4	11	5

The results for intensity are quite similar to those for F0. In 71% of CV'V-words, there is an early TP and in 29% of CV'V-words it is late. A similar tendency can be observed in CVV-words: 63% of these words have an early TP, and 37% have a late TP. The intensity TP does not appear to differentiate CV'V-words from CVV-words very much. However, it was observed that CV'V-words and CVV-words were differentiated by (1) a short drop and rise in the intensity curve or in the sound wave between vowels (see Figure 2), or (2) a sudden drop in intensity that occurs in CV'V-words, but not in CVV-words. Methods for analysing and presenting changes in intensity curves will be considered in future research.

4. Discussion

In Leivu disyllabic /h/-words, the loss of intervocalic /h/ occurred in 80% of all tokens (24 tokens out of 30). The loss of intervocalic /h/ has also been found in Standard Estonian where it occurs more often in informal speech than in formal speech (23% vs. 6%); however, in Standard Estonian the most common variant of intervocalic /h/ is a voiced variant (86% in formal and 68% in informal speech) (Teras 2018: 885).

In Leivu CV'V-words, the average duration of syllable nuclei is on average longer than in CVV-words, but there is variation depending on syllable and C2 type. In this respect, Leivu differs from Latvian and Livonian where long vowels in broken tone words have been found to be shorter than in words without broken tone (Kariņš 1996, Bond, Markus & Stockmal 2016, Teras & Tuisk 2009, Tuisk 2015).

In most cases (17 tokens out of 24) in words where intervocalic /h/ is lost, the break (a short drop and rise or a sudden drop in intensity) divides two identical or different vowels into two parts: V1 is usually longer than V2 (average duration ratio: 1.56, see Table 6). Eberhard Winkler (2010: 71) has also pointed out that broken tone is characterised by a break, which divides a vowel or a diphthong into two parts, with the first component longer than the second component. Among CV'V-words, there is a larger percentage of cases where V1 is longer than V2 than among CVV-words (67% vs. 39%).

Salme Nigol (1955: 149) noted that in quality-alternational words, the first component of the diphthong is pronounced longer than the second component: *susi: soed* > *sòì²* 'wolf, PL.NOM', *mägi: mäel* > *mäil* 'hill, SG.ALL', *pagema: paeda* > *pàida²* 'to escape'. Quality-alternational words also occurred among the words analysed for this study. The average vowel durations in CVV-words where the diphthong occurs in quality-alternational words with consonant loss, as well as in non-quality-alternational words, are presented and compared to CV'V-words in Table 6. In 50% of quality-alternational words, V1 is longer than V2 (ratio: 1.68). However, V1 can also be longer in words without quality-alternation, though this is found in only 35% of cases (ratio: 1.3). The duration ratio of V1 and V2 in CV'V-words where V1 is longer than V2 is similar to that of quality-alternational words (1.56). However, vowel duration ratios in CV'V-words resemble those of CVCV-words (Q1), in which there also appears to be quite considerable variation (Teras 2011:

166–167): in 57% of tokens, the ratio was greater than one – 1.53, and in other tokens, the ratio was less than one – 0.73. Latvian influence can probably be seen in this variation, because in Latvian CVCV-words, the first syllable vowel has greater duration than the second syllable vowel (duration ratio: 1.2–2.0, Lehiste et al. 2008: 54).

Table 6. Vowel durations (in ms) in CV’V-words and in CVV-words without quality alternation (no C loss) and with quality alternation (C loss).

Word type	N	V	No C loss			C loss		
			V1	V2	V1/V2	V1	V2	V1/V2
CV’V-words	–/14	V1 longer				171	111	1.56
	–/7	V1 shorter				120	182	0.69
CVV-words	24/12	V1 longer	141	110	1.3	174	112	1.68
	44/12	V1 shorter	100	132	0.78	114	155	0.75

Laryngealisation or creaky voice is considered the main characteristic of Danish stød (cf. Grønnum 2014). Laryngealisation or even glottal stop have also been named as one of the characteristics of Latvian and Lithuanian broken tone (Lehiste 1969, Kariņš 1996, Balode & Holvoet 2001). In Livonian, laryngealisation occurs more often in read than in spontaneous speech (Tuisk 2015). In Leivu CV’V-words, laryngealisation occurred in 7 tokens out of 24, where the final part of the syllable nucleus was pronounced as laryngealised. However, laryngealisation should be analysed more closely in future research.

In Leivu accented CV’V-words, the fundamental frequency TP is early and occurs in the first part of the syllable rhyme (23%) in almost all cases (except one token). An early F0 TP is also found in 73% of CVV-words, while in other cases, the TP is late (27% vs. 72% of the total duration of the syllable rhyme, respectively). An early F0 TP has also been found to be the most stable characteristic of Livonian broken tone words (Tuisk 2015). In CV’V-words, F0 at the beginning of the syllable nucleus and at the TP is a little higher and the decrease from the TP to the end of the word is greater than in CVV-words. A tendency for F0 to be higher at the beginning of words with broken tone than in words without broken tone has also been observed in Livonian (Teras & Tuisk 2009) and in Danish (Fischer-Jørgensen 1989, Grønnum 2015). Paul Kiparsky (2017: 201) explained the fall from high to low tone in

Livonian broken tone syllables where an intervocalic /h/ had been lost as “a continuation of the word’s pre-contraction tone contour”. That could well explain why Leivu CV’V words have quite consistently an early F0 TP, i.e., a fall from high to low tone. Leivu Q1 words also tend to have a late F0 TP, which means that F0 rises in the first syllable and falls after that (cf. Teras 2011: 168). When /h/ is lost, moving from high to low tone occurs in the broken tone syllable.

With respect to intensity at the beginning, at the TP, and at the end of the voiced part of the syllable rhyme, there is no major difference between CV’V- and CVV-words. Other methods for analysing intensity should be considered in future research. A short drop in the intensity curve or sound wave often appeared to occur between the two vowels in CV’V-words. Such a drop in intensity has also been described in Livonian (Tuisk 2015) as has a sudden fall in intensity in Lithuanian (Balode & Holvoet 2001).

5. Conclusion

Broken tone found in Latvian – as well as in Livonian, Lithuanian, and Danish – was also developing in Leivu South Estonian. The acoustic characteristics of broken tone found in these languages were considered in Leivu. Disyllabic words where intervocalic /h/ has been lost were analysed and compared to monosyllabic words. An intervocalic /h/ was almost always lost (except in 6 tokens out of 30).

Vowel duration in Leivu CV’V-words tends to be somewhat longer than in CVV-words, but there is variation depending on syllable structure. In CV’V-words, two identical vowels or two different vowels can often be separated by a break (e.g., a short drop in intensity). In such cases, the first vowel tends to be longer than the second vowel (duration ratio: 1.56). This ratio resembles that of Leivu CVCV-words where the first syllable vowel is often longer than the second syllable vowel. The first component of diphthongs in quality-alternational CVV-words is also often longer than the second component (duration ratio: 1.68).

In some cases, the final part of the syllable nucleus is laryngealised in CV’V words. Fundamental frequency in accented CV’V-words is almost always falling (an early F0 TP occurring at 23% of the total duration of the syllable rhyme). A falling F0 contour from high to low

can be seen as a continuation of the F0 contour in CVhV-words after the loss of /h/. In accented CVV-words, the F0 TP is also often early (occurring at 27% of the total duration of the syllable rhyme), but in 27% of tokens the TP was late (occurring at 72% of the total duration of the syllable rhyme).

The study of broken tone in Leivu should be expanded to trisyllabic and longer words where loss of intervocalic /h/ occurs, in order to increase our understanding of the acoustic characteristics of broken tone and determine whether the tendencies observed in this study are also found in longer words.

Acknowledgements

The author would like to thank the two anonymous reviewers for their valuable comments on and suggestions for this article, and Uldis Balodis for his English-language editing.

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Kokkuvõte. Pire Teras: Katketoon leivu CV’V-sõnades. Leivu on üks lõunaesti murretest, mida räägiti Ida-Lätis ja mida mõjutas läti keel. Üks neist mõjudest on tõenäoliselt katketoon, mis oli tekkimas peamiselt esmavähtelistes sõnades /h/ kao tulemusel. Liivi keeleski on katketooni kujunemise üheks põhjuseks peetud just /h/ kadu. Selle töö eesmärk on välja selgitada, mis iseloomustab leivu /h/-kaoliste CV’V-sõnade hääldust ja mis eristab neid kolmandavähtelistest CVV-sõnadest. Analüüsiti häälikukestusi, põhitooni- ja intensiivsuskontuure. Vokaalikestus on leivu CV’V-sõnades veidi pikem kui CVV-sõnades. CV’V-sõnades võib toimuda intensiivsuse langus ja tõus või järsk intensiivsuse langus nii kahe ühesuguse kui ka erineva vokaali vahel: esimene vokaal on enamasti kestuselt pikem kui teine. Ka CVV-sõnade hilistekkelistes diftongides on esimene osis sageli pikem kui teine. Mõnel juhul larüngaliseerub CV’V-sõnades silbituuma lõpuosa. Põhitoonikontuuris on CV’V-sõnades palju järjekindlamalt varane pöördepunkt ja langev põhitoon kui CVV-sõnades, kus tuleb ette ka hilise pöördepunktiga tõusvat põhitooni.

Märksõnad: sõnaprosoodia, katketoon, lõunaesti keel, keelesaared, leivu