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On the Secondary Rhythmical Stress in the Connecting Vowels of the Standard Lithuanian Compounds

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Abstract. The aim of this pilot study is to find out whether a secondary rhythmical stress exists in the connecting vowels of the standard Lithuanian compound words analyzed. To reach this aim, 12 respondents of both genders (6 males and 6 females) and different ages (between 25 and 50) were asked to record 12 sentences with Lithuanian compounds. Each respondent recorded the sentences 3 times. Afterwards, connecting vowels that are two syllables away from the main stress were compared with those that are one syllable away by the following parameters: the duration, the average and maximum pitch (male and female voices separately), and the average and maximum intensity. Results of this pilot study have shown that a secondary rhythmical stress does not exist in the connecting vowels analyzed.

Keywords: secondary rhythmical stress, connecting vowel, compound word, standard Lithuanian language

1. Introduction

Some research shows that in the grammatical roots of standard Lithuanian compounds there does exist a secondary stress (Vaitkevičiūtė, 1960). However, there are no investigations regarding the secondary rhythmical stress in connecting vowels[1].

[1] The connecting vowel is an element of a compound word structure. It appears between grammatical roots of a compound. Some researchers also use the term *linker vowel* (eg. Gouskova and Roon (2013)).

Therefore, the aim of this pilot study is to find out whether a secondary rhythmical stress does exist in the connecting vowels of the standard Lithuanian compound words analyzed.

Secondary stress often occurs in compound words which are made of two or more grammatical roots. Usually, one grammatical root gets the main stress and another gets a secondary stress.

The following can serve as examples of English compounds: ˌ*loud*ˈ*speaker*, ˈ*type*ˌ*writer*, ˈ*suit*ˌ*case*, ˌ*under*ˈ*stand*, ˌ*over*ˈ*look*, ˌ*out*ˈ*run*, ˈ*earth*ˌ*quake*, ˈ*life*ˌ*boat*, and ˈ*air*ˌ*cushion* (Ul Hassan, 2012, Yurtbaşı, 2017, Dabouis 2020). Secondary stress also exists in those English compounds which have second elements such as -*meter* or -*worthy* (Dabouis, 2020), e.g., *ther*ˈ*mo*ˌ*meter*, and ˈ*trust*ˌ*worthy*. According to Yurtbaşı (2017), as regards the secondary stress, there is a significant combination of accent and tone in the English language.

Myrberg and Riad (2015) found that there is a well-structured system of secondary stresses in Swedish compound words, for example in words ˈ*vattenakro*ˌ*bat* (en. *water acrobat*) and ˈ*sommar*ˌ*ledig*ˌ*heten* (en. *summer holiday*). The relation between mainly stressed, secondarily stressed, and unstressed syllables in Swedish is mostly defined by the presence of the tone accent.

A secondary stress is found in some Italian compounds (Bertinetto and Loporcaro, 2005): *ap*ˌ*pen*ˈ*diabit* (en. *dress-hanger*), ˌ*tossicodipen*ˈ*dente* (en. *drug-addict*), ˌ*porta*ˈ*fogli* (en. *wallet*), ˌ*copri*ˈ*letto* (en. *bedspread*), ˌ*apris*ˈ*catole* (en. *can opener*), ˌ*caposta*ˈ*zione* (en. *station-master*), and ˌ*temperama*ˈ*tite* (en. *pencil-sharpener*). In the Italian language, stress correlates with duration, intonation, and intensity.

Kleber and Klipphahn (2006) state that secondary stress also exists in some German compounds, e.g., ˌ*Grün*ˈ*donnersˌtag* (en. *Maundy Thursday*). As primary stress, secondary stress correlates with syllable duration, pitch (f0), the first formant (F1), and the second formant (F2). Secondary stress may also appear in some Danish compounds, e.g., ˌ*sen*ˈ*sommer* (en. *late summer*) (Basbøll et al., 2011).

In terms of secondary stress in the connecting vowels, Gouskova and Roon (2013) state that this type of stress may appear in some connecting vowels of Russian words: e.g., *ль*ˌ*но*ˈ*вод* (en. *linen grower*), *зем*ˌ*левла*ˈ*делец* (en. *land owner*), *голо*ˌ*во*ˈ*ломка* (en. *puzzle*), *картофе*ˌ*леко*ˈ*палка* (en. *potato digger*), and *ль*ˌ*дообразоˈвание* (en. *ice formation*). The appearance of the secondary stress in Russian is affected by clash avoidance and sonority.

The most important research on the secondary stresses in Lithuanian compound words was carried out by Vaitkevičiūtė (1960). She found that there exists a secondary stress in compound words that contain numerals: ˈ*šešias*ˌ*dešimt* ($šeš_R$-ias_c-$dešimt_R$[2]) [²ˈʃʲæːʃʲɛzʲˌdʲɛʃʲɪmt] (en. *sixty*), *de*ˈ*vynias*ˌ*dešimt* ($devyn_R$-ias_c-$dešimt_R$) [dʲɛ¹ˈʊʲiːnʲɛzʲˌdʲɛʃʲɪmt] (en. *ninety*), *aš*ˌ*tuonias*ˌ*dešimt*ˈ*metis* ($aštuon_R$-ias_c-$dešimt_R$-met_R-is_F) [ɐˌʃtuɔnʲɛzʲˌdʲɛʃʲɪmʲtʲ²ˈmʲæːtʲɪs] (en. *eighty-year-old man*), and *pen*ˌ*kiolika*ˈ*vietis* ($penk_R$-io_c-lik_R-a_c-$viet_R$-is_F) [pʲɛŋʲˌkʲǫːlʲɪkɐ²ˈʊʲiɛtʲɪs] (en. *place that has fifteen seats*, sg. nom.). It also exists in some compound words that have prefixes: ˌ*pasigervuo*ˈ*giaudamas* (pa_P-si_d-$gerv_R$-uog_R-iau_S-dam_S-as_F) [ˌpɐsʲɪgʲæːrʊuɔ¹ˈgʲæːʊdɐˈmɐs] (en. *one who does something while collecting blackberries*), and ˌ*pasikiškiakopūs*ˈ*taudamas* (pa_P-si_d-$kišk_R$-ia_c-$kopūst_R$-au_S-dam_S-as_F) [ˌpɐsʲɪˈkʲɪʃʲkʲɛkoːpuː¹ˈstɑːʊdɐˈmɐs] (en. *one who does something while collecting wood*

[2] Meanings of symbols: P – prefix, d – reflexive marker, R – grammatical root, c – connecting vowel, S – suffix, F – flexion.

sorrels). Secondary stress also exists in some international compound words: *ˌmikrobioˈlogija* (mikro$_R$-bio$_R$-log$_R$-ij$_S$-a$_F$) [ˌmʲɪkrɔˌbʲɪjɔˈlɔgʲɪjɛ] (en. *microbiology*, sg. nom), *ˌmikro foto ˈgrafija* (mikro$_R$-foto$_R$-graf$_R$-ij$_S$-a$_F$) [ˌmʲɪkrɔˌfɔtɔ²ˈgrɑːfʲɪjɛ] (en. *a microphotography*, sg. nom.), *ˌinternacioˈnalinis* (inter$_R$-nacional$_R$-in$_S$-is$_F$) [ˌɪnʲtʲɛrnɐtsʲɪjɔ²ˈnɑːlʲɪnʲɪs] (en. *international*, sg. nom.), *ˌkontrataˈka* (kontr$_R$-atak$_R$-a$_F$) [ˌkɔntrɐtɐˈkɐ] (en. *counter attack*, sg. nom.), and *ˌlandˈšaftas* (land$_R$-šaft$_R$-as$_F$) [ˌlɐnt²ˈʃɑːftɐs] (en. *landscape*, sg. nom).

To reach the aim of this research, 12 respondents were asked to record 12 sentences with Lithuanian compounds *kitaˈtautis* (kit$_R$-a$_c$-taut$_R$-is$_F$) [ˌkʲɪtɐ²ˈtɒʊˑtʲɪs] (en. *foreigner*, m. sg. nom.), *kitatauˈčius* (kit$_R$-a$_c$-tauč$_R$-ius$_F$) [kʲɪtɐtɒʊˈʧʲʊs] (en. *foreigner*, m. pl. acc.), *kietaˈkaktis* (kiet$_R$-a$_c$-kakt$_R$-is$_F$) [kʲiɛtɐ²ˈkɑːktʲɪs] (en. *diehard*, m. sg. nom), *kietakakˈčius* (kiet$_R$-a$_c$-kakč$_R$-ius$_F$) [kʲiɛtɐkɐkˈʧʲʊs] (en. *diehard*, m. pl. acc.), *dykaˈduonis* (dyk$_R$-a$_c$-duon$_R$-is$_F$) [dʲiːkɐ²ˈduɔnʲɪs] (en. *ne'er-do-well*, m. sg. nom.), *dykaduoˈnius* (dyk$_R$-a$_c$-duon$_R$-ius$_F$) [dʲiːkɐduɔˈnʲʊs] (en. *ne'er-do-well*, m. pl. acc.), *greitaˈkalbis* (greit$_R$-a$_c$-kalb$_R$-is$_F$) [grʲɛɪtɐ²ˈkɐlʲˑbʲɪs] (en. *fast speaker*, m. sg. nom), *greitakalˈbystė* (greit$_R$-ac-kalb$_R$-yst$_S$-ė$_F$) [grʲɛɪtɐkɐlʲ²ˈbʲiːsʲtʲeː] (en. *rapid speaking*, f. sg. nom.), *daugiaˈkalbis* (daug$_R$-ia$_c$-kalb$_R$-is$_F$) [dɒʊgʲɛ²ˈkɐlʲˑbʲɪs] (en. *multilingual*, m. sg. nom.), *daugiakalˈbystė* (daug$_R$-ia$_c$-kalb$_R$-yst$_S$-ė$_F$) [dɒʊgʲɛkɐlʲ²ˈbʲiːsʲtʲeː] (en. *multilingualism*, f. sg, nom.), *tuščiaˈžiedis* (tušč$_R$-ia$_c$-žied$_R$-is$_F$) [tʊʃʲʧʲɛ²ˈʒʲiɛdʲɪs] (en. *sterile*, m. sg. nom.), and *tuščiaviˈduris* (tušč$_R$-ia$_c$-vidur$_R$-is$_F$) [tʊʃʲʧʲɛvʲɪˈdʊrʲɪs] (en. *hollow*, m. sg. nom.). Each respondent recorded sentences 3 times. To get more precise results and to avoid the impact of the prosody of the phrase, sentences were constructed in a way so that every investigated word would be in the middle of the sentence: every word analyzed was neither first nor last in the sentence. Informants were of both genders (6 males and 6 females), different ages (between 25 and 50), and had different educational backgrounds: 5 Lithuanian philology, 4 English philology, 1 history, 1 philosophy, 1 social work, and 1 electrical engineering. The main criteria for selecting respondents was their ability to speak standard Lithuanian. 3 respondents were professional speakers, who work either in radio stations or at the Lithuanian Library for The Blind. 9 informants were not professional speakers; however, all these 9 respondents had a background in the humanities, so they were able to speak standard Lithuanian. While recording sentences, professional speakers used directional microphones, and non-professional speakers used a microphone that was integrated into the computer screen. Professional speakers recorded sentences by using either "Adobe Audition", or "Samplitude", while non-professional speakers used the "Praat" software. Respondents were not aware of the hypothesis under the study; hence, the absence of their knowledge about the investigation did not bias their productions.

According to the theory of metrical phonology, the secondary rhythmical stress falls on every second syllable to the left and to the right side from the primary stress (Hogg, 1987). Hence, in this research, connecting vowels that are two syllables away from the main stress were compared with those that are one syllable away. Compounds for this research were chosen according to these criteria: they had to have two grammatical roots and a connecting vowel, and the main stress had to fall either on the second root or the flexion. All the compounds were grouped into 6 pairs. In each pair, both compounds had to have the same first root and the same connecting vowel. Furthermore, in 5 pairs both compounds had the same second root. In every pair, the first compound had its primary stress one syllable away from the connecting vowel, while the second compound two syllables away. Connecting vowels were compared as follows: /ɐ/ was compared in the words *kitaˈtautis* and *kitatauˈčius*, *kietaˈkaktis* and *kietakakˈčius*,

*dyka*ˈ*duonis* and *dykaduo*ˈ*nius*, *greita*ˈ*kalbis* and *greitakal*ˈ*bystė*, and /ɛ/ was compared in the words *daugia*ˈ*kalbis* and *daugiakal*ˈ*bystė*, and *tuščia*ˈ*žiedis* and *tuščiavi*ˈ*duris*.

According to Pakerys (1982), duration, pitch, and intensity are phonetic characteristics of stress in the Lithuanian language. Therefore, an assumption could be made that vowels in syllables with a secondary stress may be longer, and may have a higher pitch and a higher intensity than in unstressed syllables. Therefore, connecting vowels were measured with "Praat" software and compared by these parameters: the duration, the average pitch of male voices, the average pitch of female voices, the maximum pitch of male voices, the maximum pitch of female voices, the average intensity, and the maximum intensity. In accordance with the recommendations of "Praat" software creators Boersma and Weenink (1991), the pitch of male voices was measured in the interval between 60 and 300 Hz, and female voices between 100 and 500 Hz. The intensity was measured in the interval between 50 and 100 dB. Statistical analysis was carried out using "MS Excel" software.

2. Duration

First of all, the duration of connecting vowels was measured (see Table 1).

Table 1. The average duration of connecting vowels[3]

	n	$\bar{x}$ (ms)	s (ms)	v (%)	95 % confidence interval (ms)	t_p > < t_α
[σ̲ˈσ]	215	72,3	17,4	24,1	69,9 ÷ 74,6	1,651 < $t_{0,05}$ = 1,996
[ˌσ̲σˈσ]	216	69,5	17,7	25,6	67,1 ÷ 71,8	

Table 1 shows that the average duration of connecting vowels that may have a secondary rhythmical stress is 2,8 ms lower than the duration of those that cannot have this type of stress at all (this difference is not statistically significant – t = 1,651 < 1,996). However, to state that there is a secondary rhythmical stress, a vowel in the syllable that may have this type of stress should be longer than in the syllable that cannot have this stress at all. Therefore, the analysis of duration does not show that a secondary rhythmical stress exists in the connecting vowels analyzed.

3. Pitch

Data of pitch shows a quite similar situation (see Table 2).

[3] Meanings of symbols: σ – syllable, ˈ – primary stress, ˌ – secondary stress, n – number of realizations, $\bar{x}$ – arithmetic average, s – standard deviation, v – coefficient of variation, t_p – value of Student's t-test, critical value of Student's t-test, [σ̲ˈσ] – compound word with a connecting vowel one syllable away from primary stress, [ˌσ̲σˈσ] – compound word with a connecting vowel two syllables away from the primary stress.

Table 2: The absolute pitch values of connecting vowels

	n	$\bar{x}$ (Hz)	s (Hz)	v (%)	95 % confidence interval (Hz)	$t_p \gtrless t_\alpha$
Average pitch of male voices						
[σ̲ˈσ]	102	114,7	27,7	24,2	109,3 ÷ 120,1	1,518 < $t_{0,05}$ = 1,972
[ˌσ̲σˈσ]	105	109,4	21,8	20,0	105,2 ÷ 113,6	
Average pitch of female voices						
[σ̲ˈσ]	106	206,6	43,5	21,1	198,3 ÷ 214,8	2,963 > $t_{0,05}$ = 1,971
[ˌσ̲σˈσ]	107	190,1	37,3	19,6	183,0 ÷ 197,2	
Maximum pitch of male voices						
[σ̲ˈσ]	102	120,6	30,2	25,0	114,7 ÷ 126,4	1,692 < $t_{0,05}$ = 1,972
[ˌσ̲σˈσ]	105	114,3	22,4	19,6	110,0 ÷ 118,6	
Maximum pitch of female voices						
[σ̲ˈσ]	106	218,6	47,8	21,9	209,5 ÷ 227,7	2,593 > $t_{0,05}$ = 1,971
[ˌσ̲σˈσ]	107	202,1	44,9	22,2	193,6 ÷ 210,6	

As can be seen from Table 2, the pitch value of connecting vowels that may have a secondary rhythmical stress is lower than the pitch value of those that cannot have this type of stress at all. The pitch results of male voices did not differ statistically significantly: an average pitch of male voices differs by 5,3 Hz (t = 1,518 < 1,972) and the maximum pitch by 6,3 Hz (t = 1,692 < 1,972). There appears to be statistical significance in the pitch results of female voices: an average pitch differs by 16,5 Hz (t = 2,963 > 1,971), and the maximum pitch also by 16,5 Hz (t = 2,593 > 1,971). However, this statistical significance does not mark a secondary rhythmical stress in the words analyzed. To state that there is this type of stress in the word, the statistically significantly higher pitch should appear in the syllable that may have this stress, but not in the syllable that cannot have this stress at all. To conclude, the pitch analysis also does not show that a secondary rhythmical stress does exist in the connecting vowels analyzed in this research.

4. Intensity

Results of intensity are also very similar (see Table 3).

Table 3 shows that the intensity of connecting vowels barely differs between the syllables analyzed. The intensity of the vowels that cannot have a secondary rhythmical stress is even slightly higher than those which may have this type of stress. Average intensity value differs by 0,1 dB, and maximum intensity value by 0,3 dB. These differences are not statistically significant (average intensity t = 0,352 < 1,966, maximum intensity t = 0,488 < 1,966). Therefore, the intensity parameter also shows that a secondary rhythmical stress does not exist in the connecting vowels analyzed.

Table 3: The absolute intensity values of connecting vowels

	n	$\bar{x}$ (dB)	s (dB)	v (%)	95 % confidence interval (dB)	$t_p \gtrless t_\alpha$
Average intensity						
[σ̲ˈσ]	215	73,0	5,6	7,6	72,3 ÷ 73,8	0,352 < $t_{0,05}$ = 1,966
[ˌσ̲σˈσ]	216	72,9	4,9	6,7	72,2 ÷ 73,5	
Maximum intensity						
[σ̲ˈσ]	215	74,8	5,7	7,6	74,0 ÷ 75,5	0,488 < $t_{0,05}$ = 1,966
[ˌσ̲σˈσ]	216	74,5	5,1	6,8	73,8 ÷ 75,2	

5. Conclusions

Although it was found that in the grammatical roots of some Lithuanian compounds a secondary rhythmical stress does exist (Vaitkevičiūtė, 1960), the results of this research show that there is no secondary rhythmical stress in connecting vowels of compounds analyzed in this research. It can be seen from the analysis of duration, average pitch (both male and female voices), maximum pitch (either male or female voices), average intensity, and maximum intensity. Nevertheless, this is only a pilot study. Although some small tendencies can be seen from this research, these findings are relevant and limited only to the data analyzed. To gain more knowledge of the secondary rhythmical stress in Lithuanian connecting vowels, further and more extensive investigations are needed.

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