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 vowels1.

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 rhythmic 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: *loudspeaker*, *type writer*, *suit case*, *under stand*, *over look*, *out run*, *earth quake*, *life boat*, and *air cushion* (Ul Hassan, 2012, Yurbaşi, 2017, Dabouis 2020). Secondary stress also exists in those English compounds which have second elements such as -meter or -worthy (Dabouis, 2020), e.g., *thermo meter*, and *trust worthy*. According to Yurbaşi (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 *vattenakro bat* (en. *water acrobat*) and *sommar ledig 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.

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., *Gründer tag* (en. *Maudy 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., *sen sommer* (en. *late summer*) (Bassboll 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: *ль но вод* (en. *linen grower*), *зем левка делев* (en. *land owner*), *голо во зомка* (en. *puzzle*), *картоф леко палка* (en. *potato digger*), and *ль, дообра жанье* (en. *ice formation*). The appearance of the secondary stress in Russian is affected by clash avoidance and sonority.

The most important clash 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: *šėšias dešimt* (*šešias-ias-dešimtis*) [še̱ʃia̱s-ia̱s-dešimtis] (en. sixty), *de’vynias dešimt* (*devynias-ias-dešimtis*) [dɛ̱vʲi̱nʲias-ia̱s-dešimtis] (en. ninety), *aš tuonias dešimt metis* (*aštuo̱nias-ias-dešimtis-metis*) [as̱tuonias-ia̱s-dešimtis-metis] (en. eighty-year-old man), and *pen koliika vietis* (*penkĭĭku-a̱s-vie̱tis*). The relation of secondary stress to some compound words that have prefixes: *pasigervuoja gaudamas* (pa̱si̱gervuo-a̱s-gau̱damas), and *pasikškiakopūs laudamas* (pa̱si̱gkiški-a̱s-kopū̱damas), and *pasiṙ̩k̩̇ko pu̱̱ma* (pa̱si̱kiški-k̩̩ko-pu̱̱ma) [si̱r̩̩kiški-k̩̩ko-pu̱̱ma] (en. one who does something while collecting blackberries), and *pasikk̩̩k̩̩ko pu̱̱ma* (pa̱si̱k̩̩kiški-k̩̩ko-pu̱̱ma) [si̱r̩̩kiški-k̩̩ko-pu̱̱ma] (en. one who does something while collecting wood

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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: mikrobioloģija (mikrəʊbɪoʊ-lopəj-əs-əʊ) [ˌmɪkroʊˈbjʊəɡə] (en. microbiology, sg. nom.), mikro foto grafija (mikrəʊ-fotəʊ-grəfə-əs-əʊ) [ˌmɪkroʊˈfəʊˌɡrəfə] (en. a microphotography, sg. nom.), internacio nālīnis (intərniʃənāləris-əs-əʊ) [ˈɪntrəˌnɪʃənəˌnælɪnɪs] (en. international, sg. nom.), kontrata ka (kontrə-tətək-əʊ) [ˌkɒntrəˈteɪkə] (en. counter attack, sg. nom.), and land šaftas (landər-safə-əs-əʊ) [ˈlændərˌʃæfts] (en. landscape, sg. nom.).

To reach the aim of this research, 12 respondents were asked to record 12 sentences with Lithuanian compounds kita tautis (kitə.təʊtəs) [ˌkɪtəˈtəʊˌtəs] (en. foreigner, m. sg. nom.), kitatau ėtis (kitə.təʊ-ə-ˌtəʊtəs) [ˌkɪtətəʊˈɪtɪs] (en. foreigner, m. pl. acc.), kieta kak tikis (kietə-ə-kaktə-ısis) [ˌkɪɛtəˈkæktəkɪs] (en. diehard, m. sg. nom.), kietakak čiūs (kietə-ə-kaktə-ısis) [ˌkɪɛtəˈkæktəkɪs] (en. diehard, m. pl. acc.), dykā duonis (dikə-ə-duonis-ısis) [ˌdɪkəˈdjuənɪs] (en. ne’er-do-well, m. pl. nom.), dykaduo nius (dikə-ə-duonis-ısis) [ˌdɪkəˈdjuənɪs] (en. ne’er-do-well, m. pl. acc.), greita kalbis (greitə-ə-kalbis-ısis) [ˌɡrɛɪtəˈkalbis] (en. fast speaker, m. sg. nom.), greitakal ėstė (greitakal-ə-ˌkælbi-ısis) [ˌɡrɛɪtəˈkælbiˈstə] (en. rapid speaking, f. sg. nom.), daugia kalb is (dauget-ə-ˌkælbi-ısis) [ˌdauʝəˈkælbiˌbɪs] (en. multilingual, m. sg. nom.), daugia kalbi stė (dauget-ə-ˌkælbi-ısis) [ˌdauʝəˈkælbiˈstɛ] (en. multilingualism, f. sg. nom.), tuščia žiėdis (tuščia-ə-ˌzjɛdə-ısis) [ˈtʊʃʧəˈdʒiədɪs] (en. sterile, m. sg. nom.), and tuščia vi doris (tušči-ə-ˌvidə-ısis) [ˈtʊʃʧəˈvɪdərɪs] (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 impact of the prosody of every word was integrated into the computer screen. Professional speakers recorded sentences by using either “Adobe Audition”, or “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 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: /u/ was compared in the words kita tautis and kitatau čiūs, kieta kaktis and kietakak čiūs,
dykaˈdunois and dykaduoˈnius, greitaˈkalbis and greitakaˈlbystė, and /e/ was compared in the words daugiaˈkalbis and daugiakaˈlbystė, and tuščiaˈžiedis and tuščiaviˈduris.

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

|      | n   | \( \bar{x} \) (ms) | s  (ms) | v  (%) | 95% confidence interval (ms) | \( t_p > t_\alpha \) |
|------|-----|---------------------|--------|--------|-----------------------------|---------------------|
| [σˈσ] | 215 | 72,3                | 17,4   | 24,1   | 69,9 ÷ 74,6                | 1,651 < 1,996       |
| [ˌσσˈσ] | 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).

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3 Meanings of symbols: σ – syllable, ' – primary stress, ‾ – 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, [σˈσ] – compound word with a connecting vowel one syllable away from primary stress, [ˌσσˈσ] – 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) | $t_p > t_\alpha$ |
|------------|------|----------------|--------|-------|-----------------------------|-----------------|
| **Average pitch of male voices** |      |                |        |       |                             |                 |
| [σ’σ]      | 102  | 114.7          | 27.7   | 24.2  | 109.3 ± 120.1               | 1.518 < $t_{0.05}$ = 1.972 |
| [.σσ’σ]    | 105  | 109.4          | 21.8   | 20.0  | 105.2 ± 113.6               |                 |
| **Average pitch of female voices** |      |                |        |       |                             |                 |
| [σ’σ]      | 106  | 206.6          | 43.5   | 21.1  | 198.3 ± 214.8               | 2.963 > $t_{0.05}$ = 1.971 |
| [.σσ’σ]    | 107  | 190.1          | 37.3   | 19.6  | 183.0 ± 197.2               |                 |
| **Maximum pitch of male voices** |      |                |        |       |                             |                 |
| [σ’σ]      | 102  | 120.6          | 30.2   | 25.0  | 114.7 ± 126.4               | 1.692 < $t_{0.05}$ = 1.972 |
| [.σσ’σ]    | 105  | 114.3          | 22.4   | 19.6  | 110.0 ± 118.6               |                 |
| **Maximum pitch of female voices** |      |                |        |       |                             |                 |
| [σ’σ]      | 106  | 218.6          | 47.8   | 21.9  | 209.5 ± 227.7               | 2.593 > $t_{0.05}$ = 1.971 |
| [.σσ’σ]    | 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) | \( \nu \) (%) | 95% confidence interval (dB) | \( t_p > t_{\alpha} \) |
|-------|--------|----------------|---------|----------|-------------------------------|----------------|
| Average intensity | [\( \sigma'\sigma \)] | 215 | 73,0 | 5,6 | 7,6 | 72,3 ÷ 73,8 | 0,352 < \( t_{0,05} \) = 1,966 |
| | [\( .\sigma'\sigma \)] | 216 | 72,9 | 4,9 | 6,7 | 72,2 ÷ 73,5 | 1,966 |
| Maximum intensity | [\( \sigma'\sigma \)] | 215 | 74,8 | 5,7 | 7,6 | 74,0 ÷ 75,5 | 0,488 < \( t_{0,05} \) = 1,966 |
| | [\( .\sigma'\sigma \)] | 216 | 74,5 | 5,1 | 6,8 | 73,8 ÷ 75,2 | 1,966 |

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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