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The Speech Rhythm of the Lithuanian and Latvian Languages

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Abstract. Studies on the rhythm of living Baltic languages are scarce (especially comparative ones) and their conclusions are usually ambiguous or even controversial. The aim of this research was to determine the values of the acoustic correlates of Lithuanian and Latvian languages and to compare them with the values found in other languages, identified by researchers as belonging to particular rhythm groups. The empirical material of this study consisted of 5 Lithuanian and 5 Latvian native speakers reading Aesop's fable *The North Wind and the Sun* in their respective native languages. The acoustic analysis of the audio recordings was performed using *Praat* and *Correlatore* applications. The analysis showed that the values of the acoustic rhythm correlates in both Baltic languages were found unequal. Nevertheless, according to the studied acoustic correlators, Lithuanian belongs to stress-timed languages, while Latvian is closer to syllable-timed languages.

Keywords: speech rhythm, Lithuanian language, Latvian language, stress-timed language, syllable-timed language.

1. Introduction

Speech rhythm is an interesting phenomenon that concerns many areas (linguistics, literary science, musicology etc.). In linguistics, rhythm is a term which refers to the perceived regularity of prominent and less prominent units in speech. These prominent units can be: a) stress (stressed vs. unstressed syllables), syllable length (long vs. short), pitch (high vs. low) on perception level and b) intensity, duration, fundamental frequency (F0) on acoustic-level. In verse these regularities can be limited by strict rules. Prose and other types of non-verse speech or texts are not characterized by strict rules of rhythm. Nevertheless, these texts or fragments of speech may have rhythmic attributes too.

The two categories of rhythm – stress-timing and syllable-timing – have been introduced by K. L. Pike [1]. D. Abercrombie [2] wrote about the distinction between these two types of rhythmic structure: stress-timed languages are characterized by foot isochrony, while syllable-timed languages are characterized by syllable isochrony. Later the hypothesis was put forward by P. J. Roach [3]: a) if the duration of syllables is equal in syllable-timed languages, the variability of inter-stress interval duration is large; for this reason, in syllable-timed languages stressed syllables are unevenly spaced; b) if the duration of syllables is irrelevant in stress-timed languages, the

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variability of syllable length is large. To prove this hypothesis, Roach calculated and compared the variation of syllables and foot duration. The results did not prove the hypothesis; and Roach proposed a new idea about the quantification of speech rhythm: stress-timed languages allow complex consonant clusters and vowel reduction; consequently, there is a high variation of consonant clusters and vocalic intervals. This idea was examined by R. M. Dauer [4] who attributed the impression of stress-timing or syllable-timing to structural properties of languages, such as absence vs. presence of vocalic reduction and a complex syllabic structure. F. Ramus, M. Nespor and J. Mehler [5] calculated standard deviation and percentage of consonantal and vocalic intervals. E. Grabe and E. Low [6] normalized pairwise variability index for consonantal intervals and vocalic intervals. Some authors have proposed modifications of the formulae of acoustic correlates (e.g. Dellwo, Wagner [7]; Bertinetto, Bertini [8]; for more detailed historical overview and critical approach see Arvaniti [9], [10].

Studies on the rhythm of living Baltic languages are scarce and their conclusions are usually ambiguous (e.g. Bond, Markus, Stockmal [11]; Kazlauskienė [12]; Pukevičiūtė, Kazlauskienė [13]. On the one hand, Z. S. Bond et al. [11] in their research considered Latvian as a syllable-timed language because of the contrastive vowel duration and inflections on syllables as well as fixed stress (values of calculated variables are not mentioned in detail). On the other hand, according to A. Pukevičiūtė et al. [13] and the results of their experimental research, the measures of calculated variables and statistical analysis could assume that Latvian is closer to stress-timed rhythm. The same was also showed in the research analysing the Lithuanian language. However, acoustic variables of the latter were also calculated in the research of A. Kazlauskienė [12] who revealed that the results of the analysis of acoustic correlates are controversial and the values of the data fell between both rhythmical groups. Hence the contradictory conclusions may imply that more researches are needed to make more precise conclusions about the types of the Baltic languages.

2. Data and Methods

The aim of the research is to identify the main regularities of Lithuanian and Latvian rhythm. The empirical material of this study consists of 5 Lithuanian and 5 Latvian native speakers reading the text *The North Wind and the Sun* in their respective native languages. This Aeasop's fable was chosen and translated into the Lithuanian and Latvian languages as suggested by International Phonetic Association as a possible standard text for many phonetical or phonological research (there were 68 words in Lithuanian and 81 words in Latvian; one sample lasts approx. one minute). The audio recordings were annotated using *Praat* (http://www.fon.hum.uva.nl/praat/). The segments in TextGrid Tiers were labelled with CV (C for consonants, V for vowels), pauses were left empty. The acoustic metrics were calculated, and the charts were drawn by software *Correlatore* (*http://phonetictools.altervista.org/correlatore/,* Mairano, Romano [14]). We calculated the standard deviation of consonant intervals (Cdev), the percentage of vowel intervals (Vperc), the pairwise variability index for consonant intervals (CrPVI) and the vowel intervals (VnPVI). Our data of Lithuanian and Latvian was compared to the data of other languages provided by P. Mairano [15].

The empirical material of this study is not very large. According to the previous research, it can be assumed that it is enough data for making conclusions as no value of the particular variable could be constant in any language and the amounts of chosen

data vary. Longer records do not show unambiguous results (cf. the results of the previous study of the Lithuanian rhythm by Kazlauskiene [12] where the records of 5 speakers were analysed and each reading lasted 10 min.).

3. Results and Discussion

The variance of the analysed acoustics correlators in both Baltic languages was inherent. As we can see in Figure 1, the data in both languages is different in all cases. However, one tendency can be seen: the value of acoustic correlations associated with vowel intervals is higher in Latvian and vice versa the value of acoustic correlations of the consonant intervals is higher in Lithuanian. Therefore, we can assume that consonant intervals are more varied in Lithuanian while vowel intervals are more varied in Latvian. Nevertheless, VnPVI scores differed statistically significant (Student's test $4.338 < t_{0,05} = 2.306$).

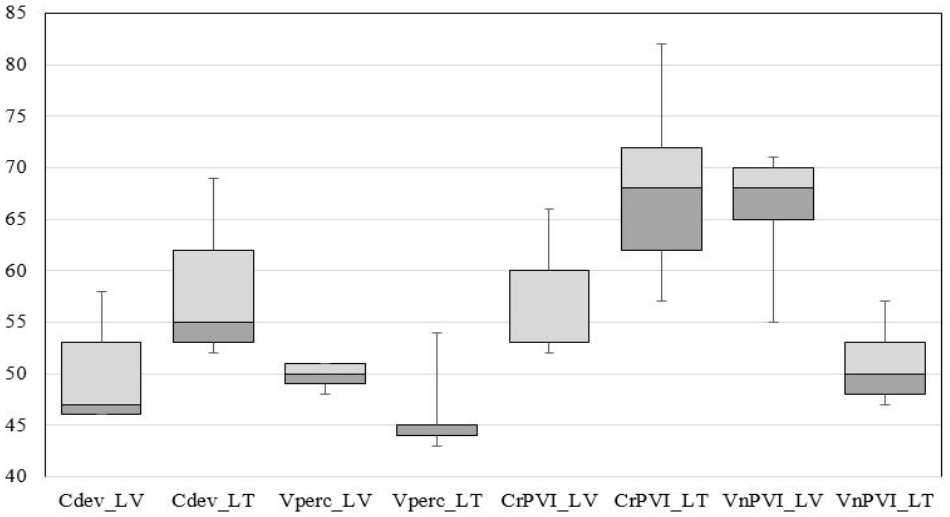

Figure 1. Cdev, Vperc, CrPVI, and VnPVI scores for Lithuanian and Latvian

Cdev shows the complexity of a syllable: 1) simple clusters of consonants are inherent to syllable-timed languages, 2) simple and complex clusters are inherent to stress-timed languages. Therefore, the high Cdev is common to stress-timed languages. Mairano [15] provides such data of Cdev: 1) for prototypical stress-timed languages from 55 to 66 (German, English, Arabic, Russian), 2) for prototypical syllable-timed languages from 37 to 52 (Spanish, French, Greek). Our study shows that the average of the Cdev of Lithuanian is 59 and 50 of Latvian. Thus, Lithuanian falls into the first group (stress-timed) of languages, while Latvian falls into the second group (syllable-timed) of languages. However, if we compare the absolute values, the results are not so unambiguous: two Lithuanian and one Latvian example do not fit into the mentioned intervals.

Cdev is related to Vperc. Simple complexity of a syllable determines a high percentage of Vperc: 1) an equal amount of vowel and consonant intervals is inherent to syllable-timed languages, 2) a large number of consonant intervals is inherent to stress-timed languages. The low Vperc is common to stress-timed languages. Mairano [15] provides such data of Vperc: 1) 40-49 for stress-timed languages, 2) 42-46 for syllable-timed languages. Since these intervals overlap, Vperc is controversial, as it does not show the difference between the two types of rhythm. Our study has revealed that the average of the Vperc of Lithuanian is 46 (Lithuanian falls into the stress-timed language group) and 50 of Latvian. In this respect, the latter would be as an unclassified language or would be closer to stress-timed languages.

The software *Correlatore* provides the opportunity to see the results visually (see Figure 2 and the following figures in this article).

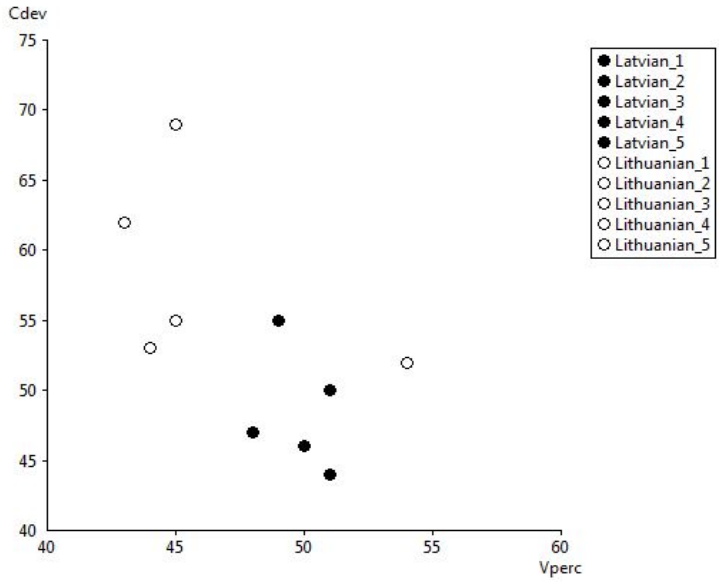

Figure 2. The distribution of absolute value in the Baltic languages according to Cdev and Vperc

Figure 2 illustrates the distribution of absolute values in Lithuanian and Latvian. As it can be seen, the variance of the absolute values was inherent in both languages, however, one tendency is observed: Vperc is almost always higher in Latvian, and Cdev tends to be higher in Lithuanian. This confirms our assumptions mentioned at the beginning of this chapter.

Stress-timed languages have high Cdev and quite medium Vperc. In diagrams they should be located in the upper two-dimensional chart, while syllable-timed languages have low Cdev and medium Vperc as well and they should be located in the lower diagram in Figure 3. The data in our research show that Lithuanian unambiguously belongs to stress-timed languages, while Latvian is closer to syllable-timed languages as it was considered by Bond et al. [11].

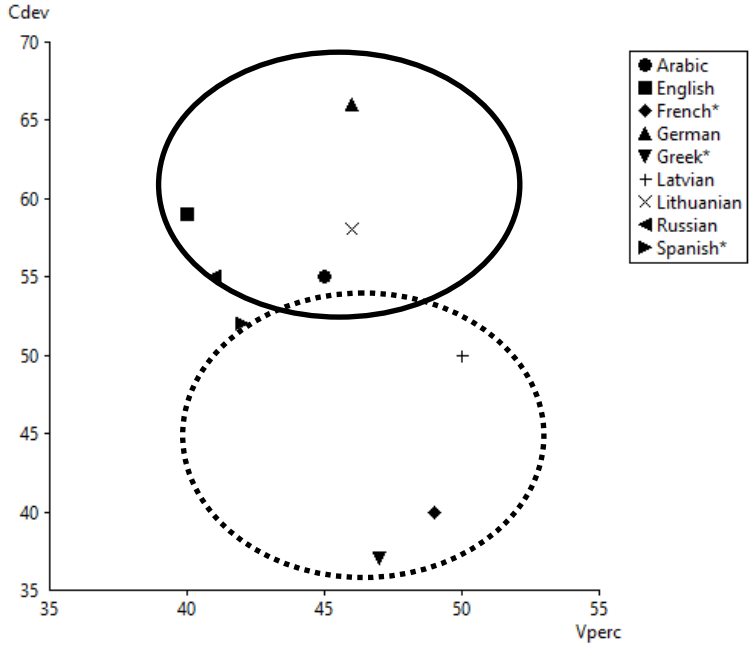

Figure 3. The distribution of languages according to Cdev and Vperc (syllable-timed languages marked with a star and circled with a dotted line, stress-timed languages are without a star and circled with a solid line)

According to pairwise variability indexes for consonant intervals (CrPVI) and vowel intervals (VnPVI), stress-timed languages are characterized by the variation of both intervals, that is, high PVI. Syllable-timed languages do not have a large variety of these intervals, especially consonant intervals (hence CrPVI is quite low). Mairano [15] provides the following data of PVI: 1) for stress-timed languages CrPVI is from 63 to 70, VnPVI is from 42 to 61; 2) for syllable-timed languages CrPVI is from 42 to 60 and VnPVI is from 45 to 60. As we can see, the intervals of VnPVI for both groups overlap and cannot be reliable criteria for classification. Our study shows that the average of the CrPVI of Lithuanian is 68 and 57 of Latvian, the VnPVI of Lithuanian is 51 and 66 of Latvian (hence Latvian could not fall into any type of the rhythm again). The absolute values of CrPVI and VnPVI vary and some of them do not fit into the mentioned intervals. Particular attention should be paid to the VnPVI's of Latvian where only one of them fits into the mentioned interval. The others are much higher.

Figure 4 illustrates the distribution of the absolute values of CrPVI and VnPVI in both languages and the variation thereof. As it can be seen, the values of these acoustic correlates are divided into two areas: one group (Lithuanian) has low VnPVI and high CrPVI, while another group (Latvian) has high VnPVI and low CrPVI.

These results determine the location of Lithuanian and Latvian VnPVI and CrPVI on the chart which illustrates the relation of the Baltic languages with others (see Figure 5). According to the data, Lithuanian belongs to stress-timed languages, while Latvian is closer to syllable-timed languages. On the one hand, the results of the measured acoustic correlators of Latvian could support the results about the type of this

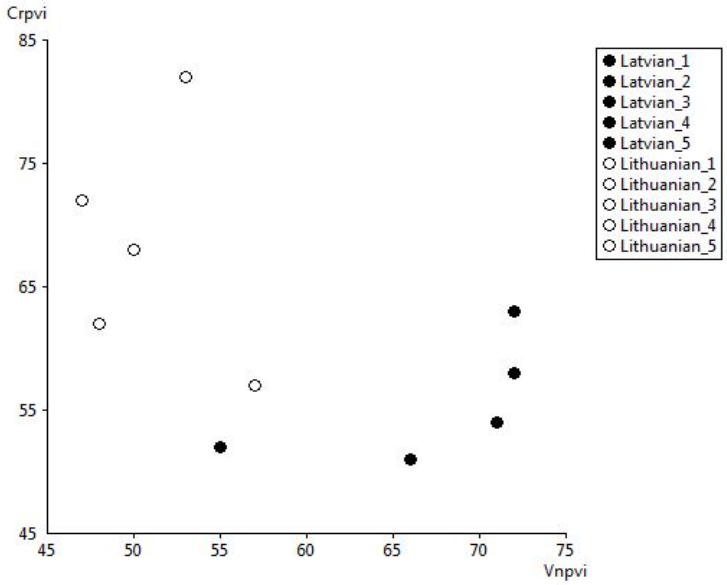

Figure 4. The distribution of absolute values in the Baltic languages according to CrPVI and VnPVI

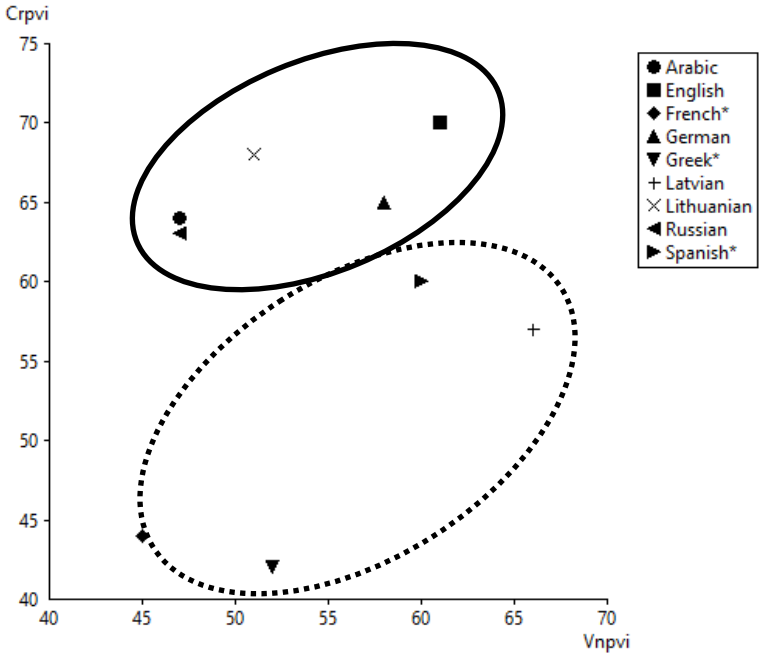

Figure 5. The distribution of languages according to VnPVI and CrPVI

language mentioned in the analysis of Bond et al. [11]. Nevertheless, they mismatch with the results provided by Pukevičiūtė et al. [13]. The results of Lithuanian support the results of the study of Pukevičiūtė et al. [13], and confirm the assumptions suggested by Kazlauskienė [12].

4. Conclusion

The data of the analysed Lithuanian and Latvian speech fragments showed that according to the values in this research, Lithuanian belongs to stress-timed languages, while Latvian is closer to syllable-timed languages, although the result is not unambiguous. On the other hand, it is possible that there are no pure stress-timed or syllable-timed languages, and it might come into question what particular or extra aspects should be investigated (Arvaniti [9]) in order to group languages according to their rhythm. However, the rhythmicality of speech cannot be denied. Therefore, research of speech rhythm remains relevant. First of all, the results of the research could be important from the linguistic typology perspective and for more successful L2 learning. Moreover, analyses of speech rhythm could be useful for the naturalness of synthesized speech, especially in case of changing the rate of synthesized speech. All metrics show that stress-timed languages have a greater variety of consonantal intervals, while in many cases syllable-timed languages can be characterised by quite an equal variation of consonantal and vocalic intervals. Such regularities should be preserved in synthesized speech. Therefore, the lengthening of vowels has a limit in case of slowing the speech rate in stress-timed languages.

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