

# Prosodic and Rhythmic Patterns Produced By Native and Non-native Speakers of a Quantity-Sensitive Language

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## Abstract

Native speakers and learners of Latvian read isolated words and a short text, designed to inventory the prosodic patterns of the target language. The learners did not match native speaker patterns on any of the prosodic properties examined: contrastive vowel durations, syllable intonations, stress or rhythm. Rather, their productions were strongly influenced by the prosodic patterns of their native language, Russian.

## 1 Introduction

As part of a study of the acquisition of prosodic patterns in L2, we have investigated vowel quantity, syllable intonations, stress and rhythm as produced by Russian speakers of Latvian. The two languages differ in their use of prosody. Latvian employs syllable rhythm, contrastive vowel quantity, fixed stress, and pitch inflections on syllables, commonly known as syllable intonations; Russian employs stress-based rhythm and variable stress; it lacks contrastive vowel quantity and has no analogue to syllable intonations [1, 2].

Because of these extensive differences in prosody, the two languages provide a valuable comparison of the acquisition of the prosody of a second language.

## 2 Method

### 2.1 Talkers

Ten ethnic Russian talkers recorded isolated words and a short passage in Latvian, designed to inventory the segments and prosodic patterns

of the language. Ten native speakers of Latvian recorded the same materials. All the talkers are long-term residents of Riga, Latvia, varying in gender and age, from 15 to 75 years. By self-report, the Russian talkers differed considerably in their use of Latvian.

### 2.2 Measurements

The non-native pronunciations were transcribed. Vowel durations were determined from spectrograms of isolated words. For assessing rhythmic patterns, the durations of vocalic and consonantal intervals were measured from spectrographic displays of sentences excerpted from the continuous text. Measurements were made using the Kay Elemetrics CSL program.

## 3 Results

### 3.1 Vowel quantity

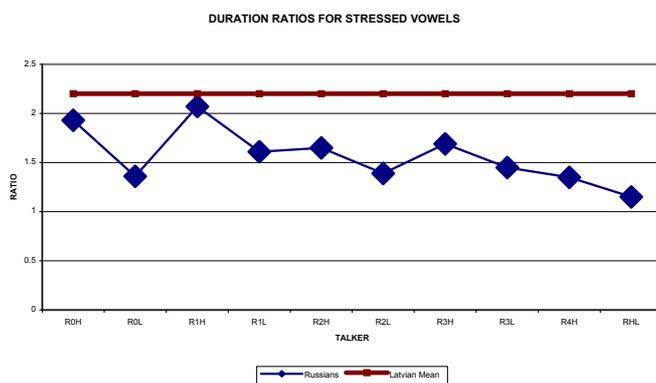
Latvian employs contrastive vowel length which can occur in any syllable of a word. Although the acquisition of contrastive vowel quantity has not received much empirical attention, it appears to be quite challenging unless their native language employs an analogous property. For example, McAllister, et al. [3] report that learners of Swedish from Estonia, speakers of a quantity-sensitive language, were better than English-speaking learners in producing appropriate Swedish vowel durations. Markus and Bond found that stress and vowel duration interacted in the speech of Russian learners of Latvian [4].

As one might expect, these Russian talkers found vowel quantity difficult, and did not clearly differentiate long from short vowels. When expressed as ratios, the durations of long and short vowels consistently fell below the

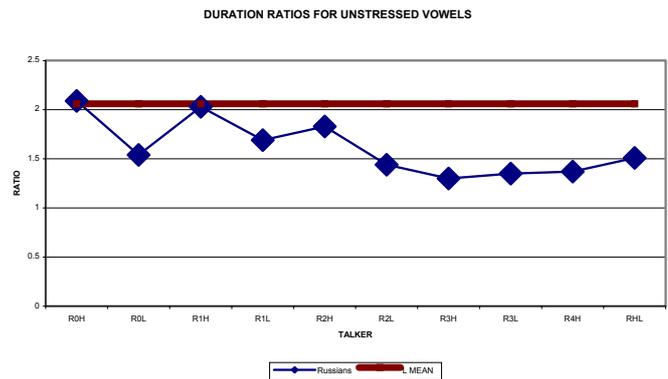
values found for native Latvians. For the Latvians, long vowels in stressed syllables have more than twice the duration of short vowels. Only two of the Russians approximated this value. These comparisons are given in Fig. 1. The Russian talkers are classified by age and by experience with Latvian.

The ratios reflect the fact that the Russian talkers shortened standard Latvian long vowels, as in *kajas* 'feet,' *pec kartas* 'in order,' *zale* 'grass,' *žust* [ʒust] 'dry'); and they prolonged short vowels in stressed syllables: *Līdija* [Li:dija], proper name; *mēdus* [me:du:s] 'honey,' *rāža* [ra:ʒa] 'harvest,' *pūķe* [pu:ce] 'flower,' *ēzers* [e:zers] 'lake,' *dārba* [da:rba] 'work,' *kļavu lāpas* [kļavu la:pas] 'maple leaves,' *ģimene* [ji:mene] 'family.'

Fig. 2 gives the long-short vowel ratios found in unstressed syllables. The Russian talkers shortened long vowels, as in *negadījumi* 'unfortunate events,' *novakti* 'gathered,' *paklausīties* 'listen,' and *skolotājs* 'teacher' and prolonged short vowels in syllables which would receive stress in Russian analogues, as in [poli:tika] *po•li:tika*, *televi:zors* *tele•vi:zors*, [dire:ktors] *di•re:ktors*; rarely, they prolonged vowels in unstressed syllables in multi-syllabic words without Russian analogues: [kartu•pe:li] 'potatoes', [dʒemperi:s].



**Figure 1.** Average ratio of long to short vowels as produced by Russian talkers for whom Latvian is a second language. The ratio for native speakers of Latvian is provided for reference.



**Figure 2.** Average ratio of long to short vowels in unstressed syllables, as produced by learners of Latvian in comparison with native speakers.

### 3.2 Syllable intonations

Latvian employs pitch contours on syllables, traditionally called syllable intonations. The standard language employs three intonations, 'broken', level, and falling. Most residents of Riga use two intonations. Although intonations are contrastive, speakers are highly variable in how they realize them and can be understood without any syllable intonations at all.

None of the Russian talkers produced contrastive syllable intonation. They neutralized minimal pairs which differed only in syllable intonations, pronouncing them with an intonation resembling a prolonged fall in pitch.

### 3.3 Stress

Latvian stress is fixed on the initial syllable. According to native listener judgments, the Russian talkers were accurate in producing this stress pattern in common two-syllable words. They made mistakes in words which occur in their native language, but are pronounced with stress on a different syllable in Latvian, e. g. *agro•nomija*, *po•litika*; some talkers also used inappropriate syllable stress in longer words, e. g. *nepa•darīsi* [*nepa•dari:si*] 'will not do'. Almost 70% of the talkers made these kinds of mistakes.

### 3.4 Rhythm

According to traditional descriptions as well as the criteria suggested by Dauer [5], Latvian employs syllable rhythm whereas Russian is a stress rhythm language. Currently, there is considerable interest in developing acoustic-phonetic measures of rhythmic properties and perhaps employing these properties to

characterize non-native speech rhythm. Both Grabe, et al. [6] and Ramus, et al. [7] have proposed metrics for classifying languages according to rhythm type. Low, et al. [8] have employed the Grabe metric to examine British vs. Singapore English rhythm.

The Ramus metric is based on segmentation of speech into consonants and vowels, specifically the proportion of vocalic intervals and the variability (standard deviation) of consonantal intervals within a sentence. In general, languages employing syllable rhythm would be expected to exhibit a higher proportion of vocalic intervals and less variable consonant intervals than languages employing stress-based rhythm.

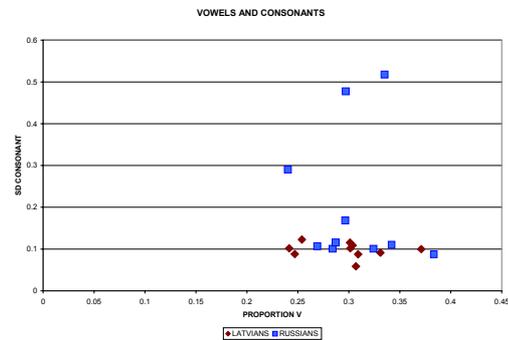
The Grabe metric is based on the insight that stressed and unstressed vowels in languages employing stress rhythm vary widely in duration, whereas the durations of vowels in syllable rhythm languages vary less. Grabe's pair-wise variability index (PVI) exploits this observation. It is calculated from the absolute value of differences in vowel duration between successive syllables divided by the average duration of the pair. Languages employing stress-based rhythm would be expected to have relatively large PVI values because the durations of vowels in successive syllables vary. Languages employing syllable rhythm would be expected to have relatively low PVI values

In this study, both the Ramus and Grabe metrics were calculated for the same set of sentences as read by native Latvian talkers and ethnic Russians. Vocalic intervals contain both vowels and diphthongs while consonantal intervals consist of all consonants between vowels.

The Russians did not differ from the Latvians on one of the dimensions of rhythm suggested by Ramus, overall proportion of vocalic intervals. Apparently, the overlapping distributions of vocalic intervals produced by the two groups are as much a function of a language as of a talker. Several of the Russian talkers differed from the native Latvians on the second dimension, variability of consonantal interval. This variability can be attributed to excessive, hesitant prolongations present in their speech. These data are given in Fig. 3.

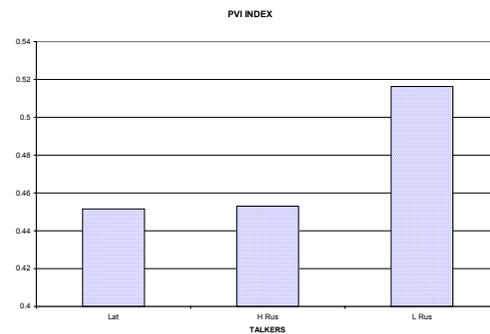
The Grabe metric, PVI, seems to distinguish between the less proficient Russian talkers vs.

the more proficient Russians and the Latvians. These data are given in Fig. 4.



**Figure 3.** The Russian talkers do not differ from the Latvians in proportion of vocalic intervals. Some show exceedingly variable consonant durations.

The PVI reflects differences in vowel duration resulting from both vowel reduction and vowel quantity. It is not clear how these two sources of durational variability interact in native and non-native speech.



**Figure 4.** The proficient Russian talkers and the native Latvians show very similar values on the PVI metric. The less proficient Russians have higher PVI values, as has been found for stress rhythm languages.

#### 4 Discussion

Some Russians seem to have partially acquired regular second language patterns such as fixed stress and some aspects of rhythm; they have difficulty with complex patterns which have no analogues in their first language such as contrastive vowel duration and syllable intonations.

The Russian talkers seem to have employed duration to distinguish stressed and unstressed syllables, but had difficulty employing duration as a consistent correlate of vowel quantity. The Russian talkers also failed to produce distinctive syllable intonations, perhaps because communication is perfectly possible without them.

Lack of familiarity with some words sometimes lead to specific kinds of difficulties with appropriate vowel durations. One Russian talker divided words *nepa – darīsi* [*nepa – dari:si*] ‘will not do’, *samir – kusi* ‘damp’ into syllables although he know the meaning of them. Another Russian talker prolonged and stretched the words, particularly syllables with long vowels or diphthongs. For example, [*ka:rtupe<sup>l</sup>I*] ‘potatoes,’ [*pati:ksmes*] for *satiksmes* ‘traffic,’ [*abu – o:li*] ‘apples,’ [*ju:ra*] ‘sea’, [*kra:suota:js*] ‘painter,’ [*tatsin<sup>1</sup>a:m*] ‘paths,’ [*bu:rtsin<sup>1</sup>as*] ‘jars’, [*la:ika*] ‘weather.’

Prolongations and inappropriate segmentation also contributed to the difference between proficient and less proficient talkers as indexed by the PVI and the Ramus dimension of consonantal variability.

Finally, lack of lexical knowledge may have been responsible for hesitant pronunciation of some words. For example, the Russian talkers were unfamiliar with some common colloquial words such as: *drēgns* [*dræ:gns*] ‘cold and damp’, *sarindotas* [*sarinduotas*] ‘lined up’, *sariritinājies* [*saritina:jies*] ‘curled up’, *satiksme* ‘traffic.’ Because of unfamiliarity, the talkers pronounced the words with drawn-out intonation, repetitions, and pauses between syllables. These unfamiliar words tend to refer to nature, weather conditions, life in the country, or agricultural activity. One of the talkers admitted that he had never heard the words *novītušas* [*nuovi:tušas*] ‘withered’, *virtenes* ‘strings’ and *snaudiens* ‘nap’. It would be useful to examine the relationship between word familiarity and pronunciation accuracy in non-native speech.

Further research should examine segmental differences between native and non-native Latvian as well as interactions between segments and prosodic properties.

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