PHONETIC EVIDENCE FOR PHONOLOGICAL STRUCTURE: WORD STRESS IN LATVIAN

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ABSTRACT

Goldsmith [1] and Halle & Vergnaud [2] assume that Latvian has only word-initial stress, and cite it as an example of a language with left-headed unbounded feet. Traditional grammars such as Endzelīns [3] claim that Latvian words have secondary as well as primary stress. This paper provides phonetic and phonological evidence substantiating the claims of traditional grammars that Latvian has secondary stress.

SEGMENTAL DURATION AND STRESS

Latvian has a system of phonemically contrasting long and short vowels [4]. Bond [5] shows that the duration ratio between phonemically long and phonemically short vowels is approximately 2:1. She also shows that stressed vowels are longer in duration than their unstressed counterparts. Among consonants, phonemic length contrasts exist only for sonorants. Phonemically lengthened sonorants or "lexical geminates" occur in relatively recent loanwords, such as *panna* 'pan' and *ķemme* 'comb'. There is no phonemic length distinction for the obstruents.

In almost all Latvian words, primary stress occurs on the first syllable. The exceptions are words with primary stress on the second syllable [3, 4]. There is no dispute about primary stress in the linguistic literature. The disagreement lies in the differing claims concerning secondary stress.

EXPERIMENT

Following the suggestion of Hayes [6], I consider external phonological evidence for secondary stress. Laua [4] writes that in Latvian, voiceless obstruents lengthen phonetically following stress between two phonemically short vowels. Based upon this assertion, I designed an experiment to answer the following questions: (1) Does quantitative descriptive phonetics provide evidence that consonants are lengthening where they are predicted to lengthen? (2) Is lengthening restricted to the voiceless consonants? (3) Is lengthening restricted to the environment between a short stressed vowel and a short unstressed vowel? (4) Does the distribution of lengthened consonants provide any evidence for secondary stress?

The experimental stimuli were 39 words containing various consonants in positions where they would and would not be expected to lengthen. The words were placed in a neutral carrier phrase, repeated 10 times, and randomized. The resulting list of sentences was read by two native speakers from Riga. The sentences were recorded using a Sony WM-D6C recorder with a Sony ECM-121 stereo microphone on regular magnetic tape. The signal was digitized and analyzed using the Xwaves acoustic-phonetic analysis program on a Sun workstation. Segmental durations were recorded by measuring the signal in both the waveform and a wide band spectrogram. The measurements of the plosives include both the stop closure plus release burst, or measure from the end of voicing of the preceding vowel to the onset of voicing of the following vowel. The analyses were made using the statistical program S. All claims of statistical significance are based on t-tests set at the $p<.05$ level.

RESULTS

The experimental results confirm Laua's claims [4]. Both of my subjects showed the same patterns of segmental durations. Figures 1 and 2 show that (1) all voiceless consonants for both speakers are significantly longer than their voiced counterparts, (2) for the voiced consonants, duration is greater in the onset of the first syllable, and (3) for the voiceless consonants, duration is greater in the onset of the second syllable.

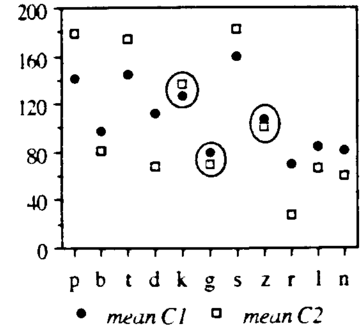

Figure 1. Mean duration (in ms) of consonants in onset of 1st syll. (C1) and onset of 2nd syll. (C2): speaker IL. Circled differences are not significant.

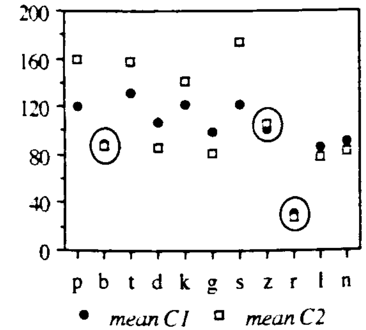

Figure 2. Mean duration (in ms) of consonants in onset of 1st syll. (C1) and onset of 2nd syll. (C2): speaker LL. Circled differences are not significant.

For simplicity of presentation, Figures 3 and 4 show only data from speaker IL. Speaker LL shows identical patterns.

Figure 3 illustrates that phonetic lengthening takes place only following stress. It is not dependent upon the position in the word alone. The word *nekad* 'never' is an exception with primary stress on the second syllable. In this figure, the mean duration of /k/ in *nekad* is significantly shorter than in all other positions.

Figure 4 shows that a voiceless consonant does not lengthen if preceded by a long vowel in the first syllable or if followed by a long vowel in the second syllable. All differences of mean duration between voiced and voiceless consonant pairs are significant.

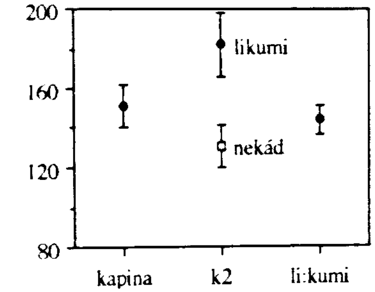

Figure 3. Mean duration (in ms) of /k/ in four words. Speaker IL. Error bars show standard deviation.

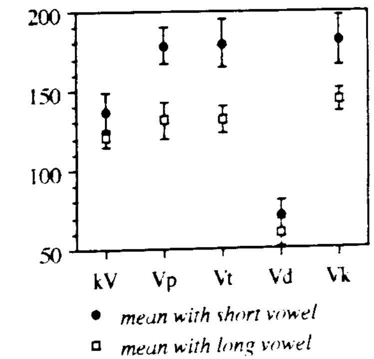

Figure 4. Mean duration (in ms) of various consonants in the onset of the 2nd syll. preceding and following long and short vowels. Speaker IL.

The explanation for the durational differences of /d/ in Figure 4 needs further investigation which is outside the scope of this paper.

Figure 5 shows that there is a significant difference for both speakers in the duration of /i/ in the third and fourth syllables of *nesalipina:t* 'to not stick together', which could indicate a secondary stress on the third syllable [5].

Figure 6 shows that for the two word *nepametams* 'not discardable' and *nesalipina:t*, the /p/ in the onset of the fourth syllable is longer in duration than in the onset of the second. This indicates a secondary stress on the third syllable precipitating the phonetic lengthening.

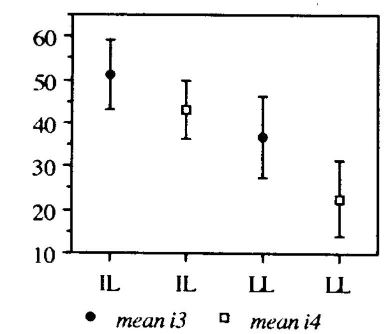

Figure 5. Mean duration (in ms) of /i/ for both speakers in nesalipina:t. *Third and fourth syllables.*

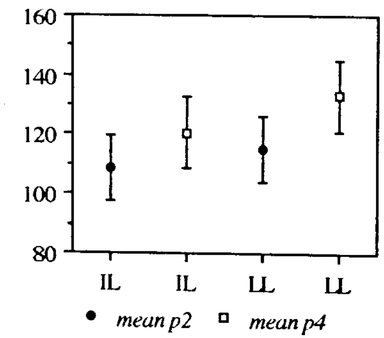

Figure 6 Mean duration (in ms) of /p/ in nepametams *(p2) and* nesalipina:t *(p4) for both speakers. All differences are significant at p<.05.*

I now turn to a phonological analysis to explain the distribution of the phonetic facts. The phonological analysis incorporates the new-found phonetic evidence for secondary stress.

PHONOLOGICAL ANALYSIS

In metrical phonology, word stress is associated with the presence of a metrical foot. Goldsmith [1] posits that Latvian words have a single unbounded left-headed foot, which is based upon his claim that Latvian words have only one stress per word, and that stress falls on the initial syllable. A problem with Goldsmith's analysis is that it does not account for the distribution of obstruent durations described above. However, the relationship between stress and consonant duration in Latvian can be understood when moras are taken into account [6, 7, 8]. I am here assuming that in Latvian, phonemically short vowels are dominated by one mora, while phonemically long vowels are dominated by two moras. In order to get the required stress patterns in Latvian, a simple Stress Condition needs to be posited for the language. *Stress Condition: Every stressed syllable must be heavy.* This means that every stressed syllable must have two moras. The first mora will by definition dominate a vowel, while the second mora can dominate either a vowel or a consonant. By assuming a quantity-insensitive system for Latvian, the first syllable will be subject to the Stress Condition, with the result that a second mora will be "inserted" in the first syllable even if that syllable has only a phonemically short vowel.

In addition to the Stress Condition, I am positing a Moraic Lengthening Rule (ML) shown in Figure 7. The second mora in the first syllable is "inserted" via the top-down assignment of metrical structure, as mentioned above.

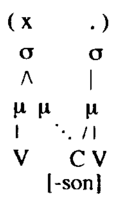

Figure 7 Moraic lengthening rule

This structure-building rule states that an obstruent in the onset of the second syllable of a foot will spread to fill an empty mora in the first syllable. The first mora in the first syllable can have an onset consonant or consonant cluster--this does not affect ML. In addition to ML, there needs to be a filter which does not allow a voiced obstruent to undergo the rule.

Applying this analysis to words in Latvian, a two-syllable word with a phonemically long vowel in the first syllable has the structure shown in Figure 9.

Figure 10 shows how the onset of the second syllable lengthens to fill the empty mora via ML if the vowel in the first syllable is phonemically short.

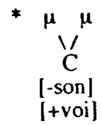

Figure 8 Filter

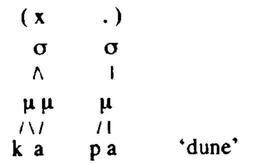

Figure 9. Phonological analysis of ka:pa.

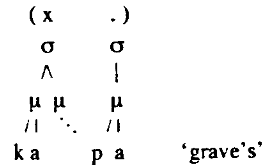

Figure 10. Phonological analysis of kapa.

In a word such as *vaga* 'furrow', the consonant will not undergo ML because of the Filter shown in Figure 8. The "empty" mora in the first syllable must either be deleted at the end of the lexicon, or else be unparsed in the output [9]. The /g/ in the second syllable cannot be syllabified in the first syllable, since syllables need onsets.

ITERATIVE BINARY FEET

Since there is phonetic evidence for vowel lengthening in the third syllable of a word, and for consonant lengthening in the onset of the fourth syllable, there must be a second foot with an empty mora in the third syllable able to undergo ML. Figure 11 shows that what Goldsmith [1] posits as the Foot layer in Latvian is actually the Word layer. Latvian metrical feet appear to be binary and iterative.

The methodology used in this paper cannot reveal the metrical status of a final phonemically long odd-numbered syllable. However, work by Hayes [6] and Kager [10, 11] suggests that such a final long syllable would indeed be footed, as shown in Figure 11.

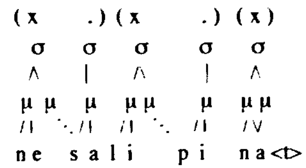

Figure 11. Possible phonological analysis of nesalipina:t.

CONCLUSION

The evidence provided in this paper suggests that Latvian has the following metrical system: a. Foot construction: i) Form syllabic (generalized? [6, 10, 11]) trochees from left to right, ii) Degenerate feet are not allowed. b. Word construction: End Rule Left.

Empirical research is still needed to determine whether Latvian builds syllabic or generalized trochees.

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