

Effect of phrasal accent on vocalic and consonantal nuclei

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The main difference between vowels and consonants is their syllable position. Vowels occupy the syllable nucleus and consonants the onset or coda. Because of this, most studies treat vowels and consonants separately. In this study, we want to examine the effect of phrasal accent on vowels and consonants when both occupy the syllable nucleus.

Slovak has two syllabic consonants, /l/ and /r/. They can occupy the nucleus of a stressed syllable, the position in which the effect of phrasal accent is expected to be most prominent. In general, prosodic prominence is predominantly carried by vowels, but this observation is usually confounded with syllable position. Slovak provides us with the opportunity to investigate whether phrasal accent can be implemented on consonantal nuclei as well.

Previous studies have revealed two strategies with which prosodic prominence is produced. The first is sonority expansion, which is achieved by expanding the oral cavity, usually by lowering jaw and tongue (Beckman et al., 1992). The second is hyperarticulation (De Jong, 1995), which does not predict a specific articulatory or acoustic movement but a more distinct realization of features. For many vowels, hyperarticulation and sonority expansion go hand in hand in terms of a wider opening of the oral cavity. Yet for consonants, hyperarticulation leads to a narrower constriction, a movement opposite to that required by sonority expansion. The predictions made by hyperarticulation is based on syllables with vocalic nuclei and consonants in onset or coda position. Therefore, prosodic emphasis thus has the effect of enhancing the distinction between nucleus and syllable edge positions. Yet whether this is a syllable position or consonant-vowel effect is unknown and is the focus of the present investigation. If the effect of prosodic emphasis is to enhance the contrast between syllable edge and nucleus, under accentuation the nucleus is predicted to become more vocalic and sonorous, independently of whether the nucleus is occupied by a consonant and a vowel. For a syllabic consonant, the consonant would thus become increasingly 'vocalic' with increasing prosodic emphasis.

In the current paper we examine, based on Slovak syllabic consonants, whether the implementation of phrasal accent on consonantal nuclei is comparable to phrasal accent on vocalic nuclei. We analyze the nucleus of the first syllable of two phonotactically legal nonsense words: *pepap* (vocalic nucleus /e/) and *plpap* (consonantal nucleus /l/). In Slovak, word stress is fixed on the first syllable and fundamental frequency is a robust indicator for phrasal accent (Kráľ, 2005). The two target words were inserted in two carrier phrases to elicit two accent patterns:

Accented target word

Pozri, ved' on mi *pepap* dal.

(Look, he even gave me pepap.)

Unaccented target word

Pozri, aj **Ron** mi *pepap* dal.

(Look, also Ron gave me pepap.)

Slovak has a dark /l/, which is produced with a consonantal tongue tip raising gesture and a vocalic tongue back retraction gesture (Sproat and Fujimura, 1993). For the vocalic tongue back gesture, both sonority expansion and hyperarticulation strategies make the same prediction. In the accented condition the tongue back is expected to further retract and the dorsum lowered compared to the unaccented condition, whereby the oral cavity expands and sonority is enhanced. For the consonantal tongue tip gesture sonority expansion, which would be expected if prosody enhances the edge-nucleus contrast, predicts the tongue tip constriction in the nucleus to weaken for the accented condition. If, however, prosodic emphasis uniformly enhances consonantal and vocalic features, both the tongue back retraction and tongue tip

constriction should be enhanced. A reduced tongue tip gesture would acoustically be reflected by a relatively higher F1 and relatively lower F2 (Lin et al., 2014), while a wider opening of the oral cavity would be reflected by a higher F1 (Harrington et al., 2000).

Acoustic recordings were made of six Slovak native speakers (five female) who read the target sentences five to six times. The syllable nucleus was segmented acoustically from the onset of voicing after the burst of the preceding /p/ until the closure of the following /p/.

To control whether phrasal accent was implemented as expected by our experimental design, we examined the fundamental frequency. The accentuation contrast is realized clearly in both nucleus types. For both nucleus types the mean F0 for the accented condition is above 250 Hz and for the unaccented condition below 200 Hz, with outliers in the lower frequencies due to the male speaker. This confirms that in terms of F0 phrasal accent is implemented on the consonantal nucleus as it is on the vocalic nucleus.

We further examined the implementation of phrasal accent by analyzing first and second formant at temporal midpoint of the nucleus. Mixed effect models were performed separately for /e/ and /l/, and for F1 and F2. PHRASAL ACCENT (two levels: accented, unaccented) was fixed factor and SPEAKER and REPETITION were random factors. P-values were obtained by testing the full model against the model without the fixed factor.

For the vocalic nucleus condition, F1 was significantly higher for the accented condition than for the unaccented ($\chi^2[1] = 33.898$, $p < 0.001$), which indicates a wider opening of the oral cavity as predicted by sonority expansion. F2 was also significantly higher in accented tokens ($\chi^2[1] = 20.754$, $p < 0.001$), which can be interpreted as either a fronted tongue or more open lips. For the consonantal nucleus F1 was significantly higher for the accented position ($\chi^2[1] = 23.464$, $p < 0.001$). F2 on the other hand did not differ significantly for the two accent conditions ($\chi^2[1] = 0.0052$, $p > 0.05$). This indicates that the oral cavity is expanded, yet the tongue tip constriction is not weakened for the accented condition.

It can be concluded that phrasal accent is implemented on both nucleus types to a comparable degree in that for both nucleus types phrasal accent has an effect on fundamental frequency and formants. In the accented condition, the oral cavity is expanded to enhance sonority for both nucleus types. For /l/, it is its vocalic gesture that contributes to it. Yet crucially, we cannot say that the consonant becomes more vocalic under accentuation. There seems to be no difference in tongue tip constriction between the two accent conditions. Our acoustic results support the notion that the retraction gesture is enhanced, but there is no concomitant weakening of the tongue tip gesture under phrasal accent. This interpretation of the acoustic results is also supported by first analyses of articulatory data which we recorded for the same speakers. In sum, our work suggests that for syllabic /l/, phrasal accent is carried jointly by the vocalic and consonantal gestures, thus /l/ does not become more vocalic under accentuation.

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