Effects of syllable onset on the timing of pitch accent in Belgrade Serbian

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Introduction In this paper, I present the results of an acoustic study on Serbian, a pitch-accent language with sonorant-sonorant onset clusters like /mr/ and /ml/. I show that peak timing in falling accents is not affected solely by syllable onset duration, as suggested by the segmental anchoring hypothesis (Arvaniti, Ladd, and Mennen, 1998), but rather is determined by an interaction between syllable onset complexity and syllable onset duration, indicating a gestural representation of tone.

I examine three simple (/r, l, m/) and two complex (/mr, ml/) onsets, in combination with falling accents (lexical H associated to an initial stressed syllable). Target words were formed using a real word (e.g. *mrave* /ˈmraːᴴve/ 'ant.ACC.PL') and changing the syllable onset to create four rhyming words (*mlave*, *mave*, *lave*, and *rave*). Five native speakers produced frame sentences with the target word in focus.

Results All syllable onsets have different durations: /r/ < /l/ < /m/ < /mr/ < /ml/ ($p < 0.0001$ for all, see Figure 1). For words with simple onsets, phonetically longer onsets push F0 peaks further from the left edge of the word (/r/ < /l/ < /m/ < /mr/, $p < 0.0001$, see Figure 2), but there is no difference between /mr/ and /ml/ ($p = 0.70$). A linear mixed effects model shows that syllable onset `Duration` is a significant predictor of peak delay ($\chi^2(1) = 293.67$, $p < 0.0001$). The interaction `Complexity:Duration` improves the model ($\chi^2(1) = 9.79$, $p = 0.002$); for complex onsets, increases in onset duration have a smaller effect on peak delay.

As the significance of `Complexity:Duration` for peak delay suggests, peaks occur closer to the start of the rime in words with complex onsets than in words with simple onsets (Figure 3): /ml/ = /mr/ ($p = 0.77$), /mr/ < /m/ ($p = 0.007$), /m/ = /l/ = /r/ ($p = 0.97$ for both). `Complexity` is a significant predictor ($\chi^2(1) = 52.16$, $p < 0.0001$ compared to the null model); unlike the peak delay model, adding `Duration` does not significantly improve the model ($\chi^2(1) = 2.96$, $p = 0.085$). Thus, peak location relative to the rime is different for categorical contrasts of simple vs. complex onsets, but not for duration as a continuous variable.

Finally, the start of the upward excursion is influenced by both syllable onset duration and complexity. Excursions start earlier in words with shorter onsets (main effect of `Duration`, $\chi^2(1) = 182.19$, $p < 0.0001$), and adding `Complexity:Duration` significantly improves the model ($\chi^2(1) = 13.61$, $p = 0.0002$). The excursion starts before or near the beginning of the word with simple onsets, and after the beginning of the word with complex onsets.

Conclusions These results are suggestive of a c-center organization of tone, as found in Thai (Karlin, 2014) and Mandarin (Gao, 2008; Yi, 2014). Unlike in Thai and Mandarin, the tone gesture in Serbian is more similar to a vowel than to a consonant in that it is the central gesture, not the displaced gesture: increased complexity causes consonants to displace away from the excursion start in both directions, rather than only to the left (Figure 4). These findings support the addition of a new role of tone gestures in a gestural representation of tone.

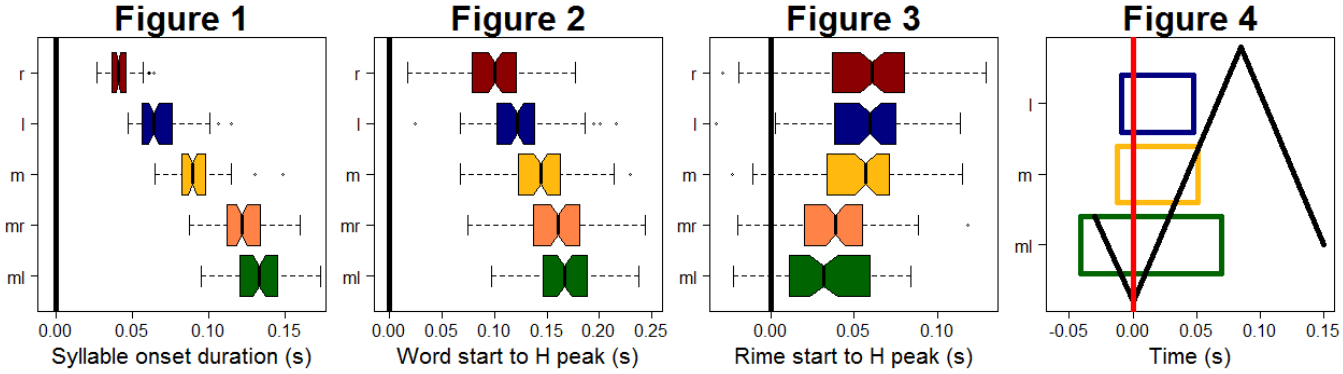

Figure 1: Box plot of syllable onset durations. **Figure 2**: Box plot of peak delay, by syllable onset. **Figure 3**: Box plot of peak to left edge rime, by syllable onset. **Figure 4**: Representative examples of /ml/, /m/, and /l/ onsets: boxes represent syllable onset duration; contour is a schematized pitch track (durations preserved, pitch height neutralized). The red line indicates excursion onset, which serves as the point of dispersion.