

Face morphology affects speech rhythm: A pilot study

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A recent study by Dellwo et al. (under revision) showed that acoustically measurable rhythmic characteristics of speech typically vary significantly between speakers, but there is very little within speaker variability. There is thus evidence that speech rhythm is to a high degree idiosyncratic as has also been shown for music by Palmer & Loehr (2013). In the present study we investigated how morphological aspects of the speaking apparatus gate individual variation. For segmental characteristics, Weihrich & Fuchs (2013) showed that the articulatory trajectory of [es] and [esh] significantly depends on the shape of the palatum. Similarly we assume that idiosyncratic rhythmic timing of speech might also be influenced by static dimensions in the vocal tract.

We measured the distance between the mandible joint and lower teeth, the maximal mouth opening angle and the maximal distance between lower and upper teeth in photographs of 17 participants (8 females, 9 males). In order to control for linguistic environment, subjects sang the melody of “Frère Jacques” by substituting the lyrics either by [da] or by [ba] syllables. Rhythm was measured as the proportion of the vowel in each syllable (%V). To assess the effect of the mandible on %V, differences in %V (Diff%V) between each individual syllable of the ba and da condition were calculated. Diff%V expresses how different [ba] and [da] syllables are. Diff%V was modelled using, apart from morphological measurements, individual speaking rate, body height, gender, tune pitch and note value as fixed effects and subjects as random effects.

Model results (Figure 1) show that, on average, females do not produce different %V between [ba] and [da]. However, higher speaking rate increases Diff%V, rendering %V in [ba] smaller than in the [da]. Increasing body height and mouth angle reduce Diff%V. All other factors did not yield any significance.

The results of this pilot study indicate that idiosyncratic effects in speech rhythm can be based in individual differences in the face and body morphology. Clearly, further investigations have to be performed by using spontaneous and controlled speech material.

Dellwo, Volker, Adrian Leemann, Marie-José Kolly (revision): "Rhythmic variability between speakers: Articulatory, prosodic and lexical factors".

Palmer, C., & Loehr, J.D. (2013): “Meeting of two minds in duet piano performance”. In L. F. Bernstein and A. Rozin (Eds.), *Musical implications: Essays in honor of Eugene Narmour* (pp. 323-338). Hillsdale, NY: Pendragon Press

Weirich, M. & Fuchs, S. (2013): “Palatal morphology can influence speaker-specific realizations of phonemic contrasts”. *Journal of Speech, Language and Hearing Research* 56, S1894-S1908.

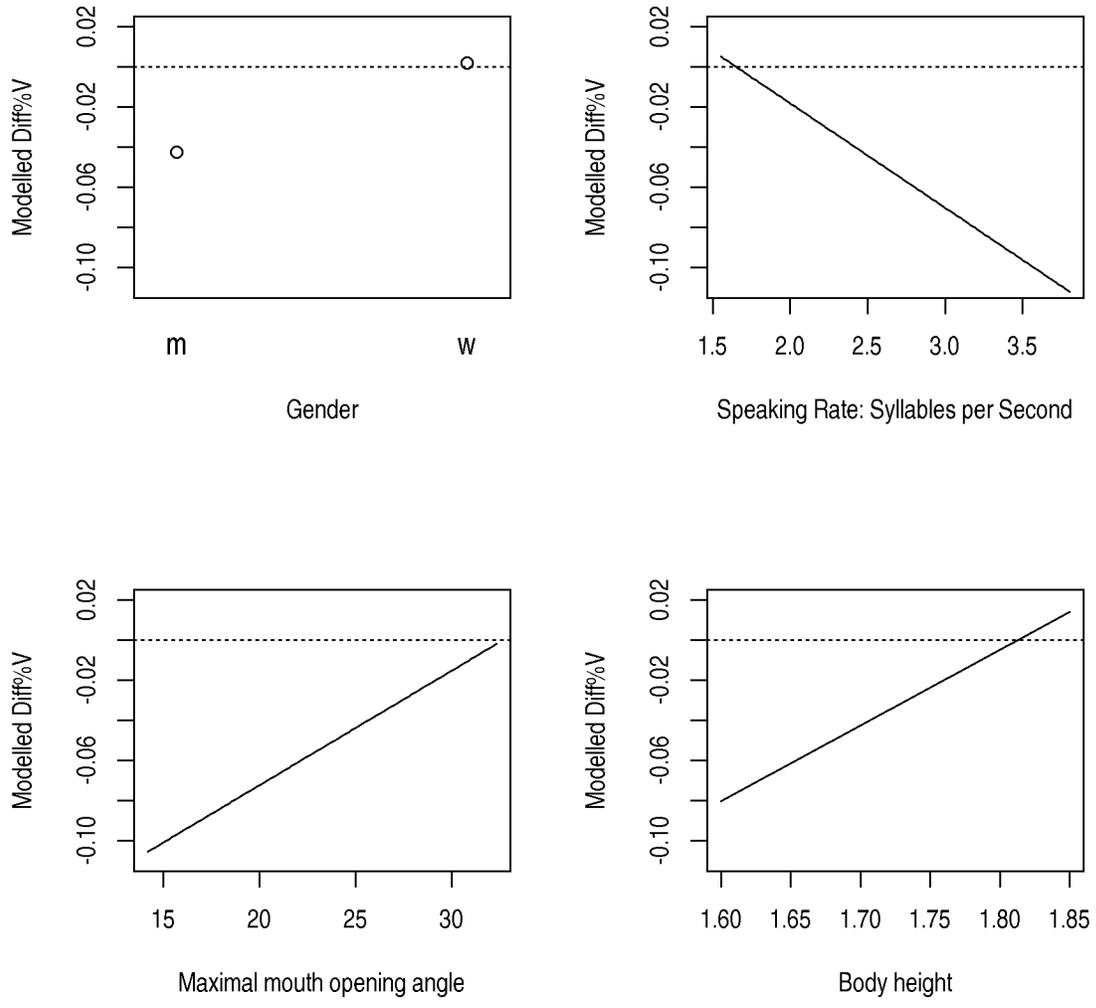


Figure 1: Visualization of mixed-effects regression model results.