

Effects of gemination on the duration and formant frequencies of adjacent vowels in Hungarian voiceless stops

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Gemination has been examined in various languages which have contrastive singleton and geminate consonants (e.g., Ham 2001; Ridouane 2007). Numerous production studies have focused on timing properties of geminates. Their findings confirmed that duration is the main acoustic cue for the distinction between singleton and geminate consonants (Ham 2001; Khattab 2007; Ridouane 2007). Closure duration is this primary cue in the case of stop consonants. However, other factors, such as intensity, spectral moments of the burst release etc. may contribute to this opposition (Local–Simpson 1999; Payne 2006; Idemaru–Guion 2008). A few studies have sought evidence for other acoustic correlates of geminates, which concern other units of speech than the target consonants (the given single or geminate consonant). Previous and following segments have also been analysed in terms of gemination. For example, gemination appears to affect the duration and quality of preceding segments in Malayalam (Local–Simpson 1999) and in Tashlhiyt Berber (Ridouane 2007).

The aim of the present study is to analyse whether gemination has an effect on the duration and formant frequencies of the adjacent vowels in Hungarian stops. Two hypotheses were addressed: 1. Vowels would be realized with shorter duration preceding geminate stops than preceding single stops. 2. Vowels would also differ regarding formant frequencies depending on singleton or geminate environment.

Ten Hungarian-speaking male subjects (aged between 20 and 29) were asked to participate in spontaneous conversation about their work and hobbies. The participants have no reported history of speech disorders. Preceding and following vowels in the environment of intervocalic singleton and geminate stops ([p, t, k] and their long counterparts) were annotated manually in Praat software (Boersma–Weenink 2013). Segment boundaries of vowels were marked at the onset and the offset of the second formant of the vowels. Duration measurements were obtained from simultaneous spectrographic and waveform displays. Formant frequencies of surrounding vowel (F1 and F2) were extracted using a script written by Morrison and Nearey (2011) in MATLAB environment. To measure formant frequency 25 ms length Hamming type window and 10 ms time step was used based on LPC analysis. In case of the preceding vowel the formants were measured at the midpoint and offset; and in case of following vowel the formants were measured at the

onset and midpoint. R (R Core Team 2012) and MCMCglmm (Hadfield 2010) were applied to perform a generalized linear mixed effects analysis of the relationship between the acoustic features of the vowels and the categories of consonant quantity. As fixed effects, we entered ‘consonant quantity’ into the model. We present confidence intervals estimated with the Markov Chain Monte Carlo method and p-values that are considered significant at the $\alpha = 0.05$ level.

Our preliminary results showed that gemination shortens vowels preceding voiceless stops. We also found minor formant differences between the adjacent vowels of singletons and geminates. Acoustic correlates of the stop length distinction may play an important role in the perceptual distinction of the contrasting sounds. Durational and formant differences between vowels surrounding singletons and geminates may help listeners in perceptual discrimination of the two phonemic categories. Results of this study may contribute to various speech applications and second language learning.

References

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