Tongue positioning during Seoul Korean lax, tense, and aspirated obstruents

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Background: Enlarging the supralaryngeal cavity volume facilitates voicing during the production of obstruents. One common articulatory adjustment to enlarge the supralaryngeal cavity, and thus to initiate or maintain voicing, is tongue root advancement (e.g., Westbury 1983, Proctor et al. 2010). In a recent ultrasound study, Ahn (2018) reports that tongue is more advanced for "voiced" than "voiceless" stops both in English and Brazilian Portuguese, suggesting that the articulatory adjustment may not be exclusively related to voicing during closure. The "voiced" stops in English, unlike those in Brazilian Portuguese, do not always feature acoustic voicing during closure. Therefore, the tongue root advanced in English "voiced" stops arguably aligns with the abstract two-way laryngeal distinction rather than with the vocal fold vibration.

The current study examines the tongue positions during the production of Seoul Korean stops and fricatives. Korean has a three-way laryngeal contrast for stops (lax, tense, and aspirated), and two-way for fricatives (lax and tense). All obstruents are produced as voiceless phrase-initially, but the lax stops undergo an allophonic voicing intervocalically. Lax fricatives are not intervocalically voiced, but are typically aspirated phrase-initially (e.g., Cho et al., 2002). By examining whether Seoul Korean obstruents demonstrate similar patterns to those in English, we primarily aim to inform the hypothesis that tongue root advancement is related to the abstract laryngeal categories. If different laryngeal categories in Seoul Korean obstruents differ in their tongue root configurations, the tongue root displacement has a different motivation than voicing during closure or frication. We also examine whether the lax stops that underwent the allophonic voicing differ from those without in their articulatory configuration.

Methods: Four adult speakers of Seoul Korean, one male and three females, participated in this experiment. All participants are self-identified as a native speaker of Seoul Korean, speak English as an additional language, and lived in VA, USA, at the time of participation.

The recording sessions were conducted at the Speech Analysis Lab at George Mason University. The acoustic and ultrasonic data were simultaneously recorded with the Articulate Assistant Advanced software (Articulate Instruments 2012). The ultrasound images of midsagittal tongue contours were obtained using a Mirco ultrasound system (Articulate Instruments), at the frame rate of 81.4 fps, 90mm depth, and 92 degrees of fan of view. The transducer was fixed in place with respect to the speaker's head using the Ultrafit headset (Spreafico et al. 2018). Audio signal was simultaneously recorded using a Røde smartLav+ microphone connected the laptop via an external Focusrite Scarlette Solo 2nd Generation pre-amplifier at the sampling rate of 22,050 Hz. The microphone was attached to the headset.

The stimuli were nonwords, /**t^h**a.**t^h**a/, /**ta**.**ta**/, /**t***a.**t***a/, /**sa**.**sa**/, and /**s***a.**s***a/, with the target consonants being bolded. Both the initial and the intervocalic obstruents were analyzed. The nonword stimuli were presented in Korean alphabet, in a carrier sentence beginning with the nonwords. Each nonword was repeated 6 times in different random orders. The entire recording session took about 60 minutes.

We analyzed the ultrasound frames during the acoustically-measured closure (for /t/, /t*/, and /t^h/) and frication (for /s/, /s*/). For the initial stops, since it was not possible to measure the acoustic closure, we analyzed three frames (approximately 35~50ms) prior to the acoustic bursts.

Results and discussion: We present preliminary findings from the male speaker's data in this abstract. Figures 1-2 present the tongue configurations during the production of the obstruents.

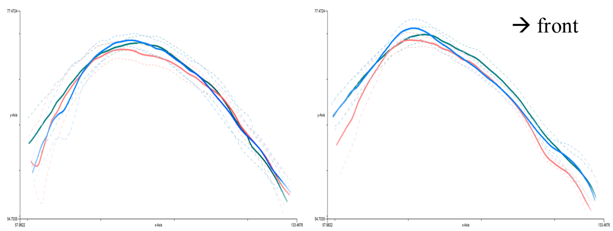

Figure 1: *Tongue configurations during /t/ (red), /t*/ (blue), and /t^h/ (green) in utterance-initial (left) and intervocalic (right) positions. Dashed lines represent 95% confidence interval.*

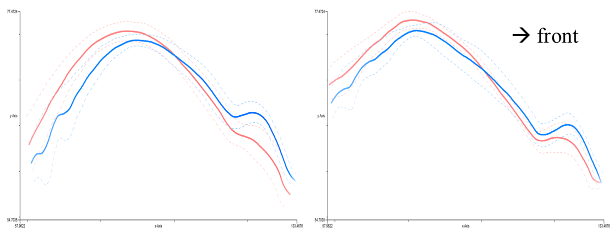

Figure 2: *Tongue configurations during /s/ (red) and /s*/ (blue) in utterance-initial (left) and intervocalic (right) positions. Dashed lines represent 95% confidence interval.*

This speaker does not seem to have distinct tongue root configurations for stops of different laryngeal categories. The intervocalic lax stops that are allophonically voiced (red line in Fig. 1, right panel) have slightly fronted tongue root than stops of other categories, but the difference is not significant. Also, there is no meaningful difference between lax and tense fricatives: if any, /s/ seems to have higher tongue body than /s*/. This suggests Seoul Korean may not have the tongue root displacement for its laryngeal categories. This would further suggest the tongue root advancement observed in English "voiced" stops (Ahn, 2018) may have a language-specific, phonological motivation rather than facilitating vocal fold vibration.

References

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