Transfer of articulatory targets in production of second language Korean sibilants

Madeleine Oakley[1], Jeff Mielke[1], and Jeannene Matthews[1]
[1]North Carolina State University

This project uses lingual ultrasound, lip video, and acoustic data to examine how L1 English-L2 Korean speakers use L1 sibilant categories to produce the Korean /s/-/s'/ contrast. The goal of this work is to contribute to a deeper understanding of the articulatory targets in second language speech sounds. It has been found that L1 English learners of Korean struggle to differentiate the tense and lax fricatives /s/ and /s'/ acoustically (Cheon, 2005). Two possibilities for why learners are non-target like in their productions of the Korean sibilant contrast are 1) learners assimilate Korean /s/ and /s'/ to the same English sibilant category, leading to production errors (Cheon, 2005) or 2) L2 Korean learners have learned that there is a contrast between Korean /s/ and /s'/, but produce the contrast in terms of place of articulation, similar to English /s/ and /ʃ/, while L1 Korean speakers do not distinguish /s/ and /s'/ using place of articulation (Cheon, 2005; Anderson et al., 2004). This experiment is designed to test whether non-target like English-Korean learners' productions of the Korean fricative contrast are, in fact, caused by learners producing both Korean /s/ and /s'/ as English /s/, or whether they are producing them with two different places of articulation, similar to English /s/ and /ʃ/.

Six L1 English-L2 Korean learners and two L1 native Korean speakers completed a production task using the Articulate Assistant Advanced (AAA). All learners were enrolled in intermediate to advanced intermediate Korean courses in the U.S. and were familiar with Korean orthography (which is transparent with respect to the /s/-/s'/ contrast). Participants first read a word list in Korean containing targets /s, s'/, followed by a word list in English, containing the targets /s, ʃ/. Each target was in the onset of 14 real words, and each was repeated twice for a total of 28 tokens per sibilant. All stimuli were presented orthographically. Participants wore a stabilization headset connected to an ultrasound probe and video camera, which recorded a frontal view of the lip opening. All audio was recorded in AAA. Audio clips were extracted out of AAA, and aligned using the Montreal Forced Aligner (McAuliffe et al., 2017). Spectra were measured using multi-taper spectral analysis in the middle 20 ms of each fricative using the SpectRum package for R (Reidy, 2013). For the articulatory analysis, tongue splines were created using DeepLabCut in AAA. The coordinates of the splines at the midpoint of each fricative were analyzed using polar SSANOVA in R.

Most learners did not produce a difference between L2 Korean /s/ and /s'/ in peak frequency, suggesting no place of articulation difference, since peak frequency is expected to correlate to the size of the oral cavity anterior to the constriction. The learners produce the Korean sibilants with a peak frequency intermediate between English /s/ or /ʃ/. Articulatory results show variation across learners. Half of the learners also produce Korean /s/ and /s'/ with similar tongue positions (See Figure 3). Other learners, however, produce Korean /s/ and /s'/ with distinct tongue positions, suggesting these sibilants have different articulatory targets (See Figure 4). Interestingly, the cross-language results show that learners do not articulatorily or acoustically produce Korean /s/ as English /s/.

These results show variation between learners, and that some L2 Korean learners do produce a difference in constriction location between Korean /s/ and /s'/, which may be caused by learners using L1 strategies to produce a non-native contrast. However, learners are not necessarily transferring constriction location from their L1 English sibilants to produce the Korean sibilants. This suggests that transfer between a learner's L1 and L2 may not be transfer of *targets* but rather transfer of strategies to produce *contrasts*.
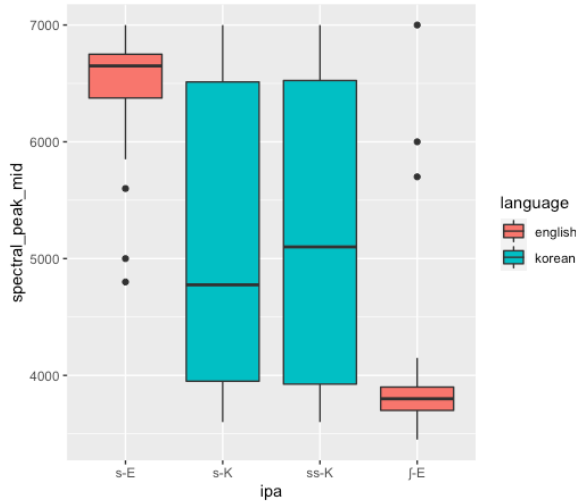
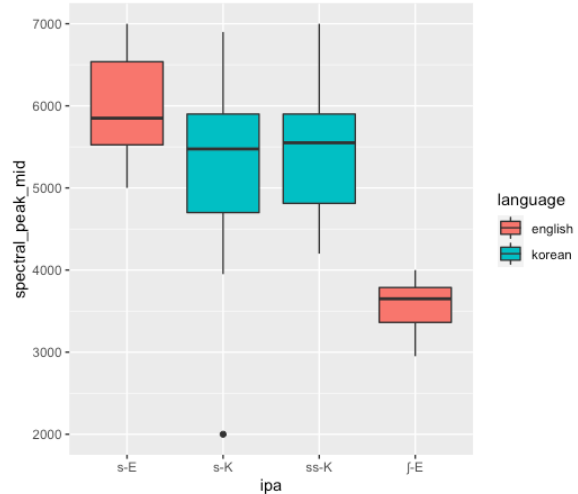Figure 1: LK5 Spectral peak values for English and Korean sibilants (Hz)

Figure 2: LK3 Spectral peak values for English and Korean sibilants (Hz)
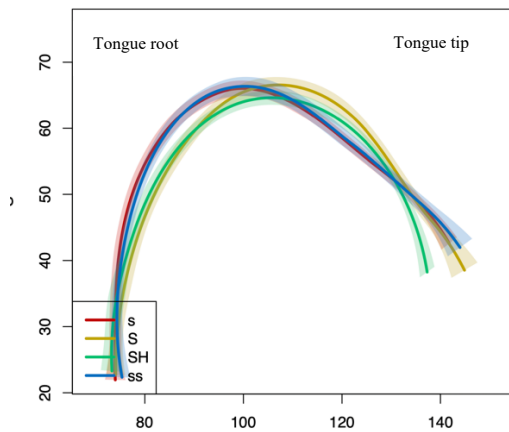

Figure 3: Speaker LK5's SSANOVAs for English and Korean sibilants (Arpabet characters "S" and "SH" correspond to English /s/ and /ʃ/ respectively, while "ss" corresponds to Korean /s'/)
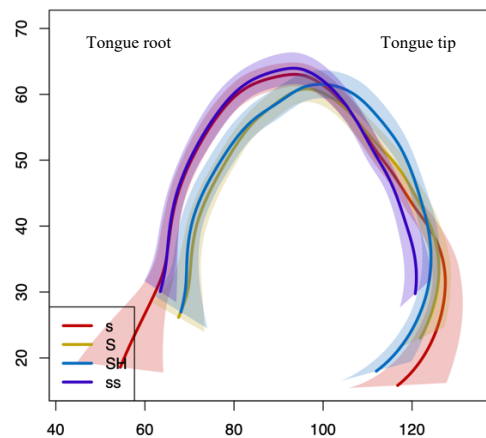

Figure 4: Speaker LK3's SSANOVAs for English and Korean sibilants (Arpabet characters "S" and "SH" correspond to English /s/ and /ʃ/ respectively, while "ss" corresponds to Korean /s'/)

References

Anderson, V., Ko, I., O'Grady, W., & Choo, M. (2004). A palatographic investigation of place of articulation in Korean coronal obstruents. *Korean Linguistics*, *12*(1), 1-24.

Cheon, S. (2005). Production and perception of phonological contrasts in second language acquisition: Korean and English fricatives. PhD dissertation, the University of Hawai'i.

McAuliffe, Michael, Michaela Socolof, Elias Stengel-Eskin, Sarah Mihuc, Michael Wagner, and Morgan Sonderegger (2017). Montreal Forced Aligner [Computer program]. Version 1.0.

Reidy, P. (2013). R Package [Online]. Available: https://github.com/patrickreidy/spectRum.