

Sex differences in voiceless fricative production in Canadian English

Nicole van Rootselaar, Amanda Scherer, Brianna Olson, Leanne Watson, Fangfang Li

University of Lethbridge, AB (CANADA)

nicole.vanrootselaar@uleth.ca, fangfang.li@uleth.ca

Background: Speech production is known to vary according to sex, both in adults and children. While there are some obvious features, such as differences in fundamental frequency, where females tend to have a higher F0 compared to males (Fant, 1960), other cues are more subtle, and less reliant on physiology. One well studied example is the sex-variant characteristics of voiceless fricatives ([s] and [ʃ]). Fox and Nissen (2005) found that for children and adults, there was a significant decline in the place of articulation for males producing the /s/ sound. While the authors stated that sex-related physiological characteristics could play a role in the noted significant differences, the appearance of the distinctions before puberty suggested that social factors played an important role in the sex-specific variation in production (Fox & Nissen, 2005). A more recent study expanded on these results to examine the role of gender identity and sex/gender difference in /s/ production (Li et al., 2016). Here, Li et al. (2016) collected data with a questionnaire on children's gender-typical behaviour as well as samples of /s/ production from a list of stimuli where the target consonant was in the initial position of the word (i.e. salmon). The results demonstrated a link between the questionnaire results and /s/ production, specifically for the boys, where the degree of gender conforming production of /s/ was predicted by the level of gender-conforming behaviour reported in the questionnaire (Li et al., 2016). Boys who exhibited more feminine traits also produced a more "feminine" /s/, a more fronted /s/.

The previously discussed studies have focused exclusively on acoustic analysis to investigate socially relevant sex-differences in production of voiceless fricatives, and more specifically, /s/. In the current pilot study, we investigated if the previously reported sex differences for sibilant fricatives can be detected with ultrasound technology in a small sample of native English speakers. Specifically, we intend to measure if there are significant differences in tongue placement between males and females during production of /s/ and /sh/ consonants. Additionally, we also plan to examine if there is significant variability of tongue position between males and females for sibilant fricative production under identical production conditions (pronouncing the same word) and varied production conditions (same sound produced in different words).

Methods: 6 university undergraduate students from southern Alberta/Canada (3 female, 3 male, native English speakers) participated in this study. We used an EchoB ultrasound system (Articulate Instrumented Ltd, 2014) with an Articulate instruments headset to record sagittal images of the tongue during speech. Recording frequency was set at approximately 100 Hz. Participants produced three reiterations of 64 phonemes based on the Goldman-Fristoe Test of Articulation 3 (Goldman, 1986). From this wordlist, we segmented words beginning with sibilant fricatives ([s] and [ʃ]) followed by different vowel environments. Words examined include: shoe, shovel, seven, slide, soap, spider, star, and swing. The target consonant was always located in the initial position of the phoneme. Using AAA software (Articulate Instrumented Ltd, 2014), we semi-automatically fitted splines to tongue contours and selected the coordinates from the first quarter, midpoint, and last quarter of the segmented target consonant tongue spline.

Results and discussion: We are still completing analysis. We plan to present data pertaining to tongue position variability, specifically sex differences related to degree of variability, as well

as examine differences in place of articulation between the sexes. We will export the data to R (Rstudio Team, 2015), where we used LMM and SS-ANOVA to assess differences in tongue position between and within speakers.

References

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