Acoustic, perceptual and articulatory properties of second language speech; A case of Japanese speakers' production of the English /l r/ contrast.

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Second language (L2) learners acquire L2 phonology based on similarities between their L1 categories and the closest L2 categories (Flege & Bohn, 2021). L2 learners have to navigate optimal articulatory properties from the acoustic signal to produce a perceivable contrast to the listeners. Although the Perceptual Assimilation Model of Second Language Speech Learning (PAM-L2) posits that L2 learners have access to the articulatory gestures to acquire L2 phonology, the focus of L2 speech learning research is largely acoustical and the articulatory mechanisms in the such process are less well-understood (Song & Eckman, 2021). For example, L1 Japanese speakers often have difficulty in making a clear, perceivable contrast between English /l r/. L1 English speakers use the distance between F3 and F2 to contrast English /l r/ whereas L1 Japanese speakers do not (Espy-Wilson, 1992; Aoyama et al., 2019). However, it is unclear what articulatory properties cause the lack of perceived contrast in English /l r/. One possibility is *covert contrast*, in which articulatory differences are indeed present but are perceptually neutralised (Song & Eckman, 2021). Therefore, we need to obtain more articulatory data and to relate it with the acoustics and listeners' judgement.

In this study, I will discuss the way articulatory properties are correlated with acoustic measures and listeners' perceptual evaluations of the production of English /l r/ by L1 Japanese speakers. Speech data were obtained from five L1 Japanese speakers (two female and three male) aged between 23 and 30 years (M = 24.6 years). Acoustics and articulatory data were collected in their production of word-initial tokens of /l/ and /r/ embedded in a career sentence, yielding 498 liquid tokens (248 /l/s and 250 /r/s). For acoustic analysis, F1 and F3 were automatically estimated and extracted at the 11 equal time points during the liquid interval, and Bark-transformed F3-F2 (Z3-Z2) is obtained using the emuR package on R. For articulatory analysis, ultrasound data were collected, and tongue splines were fitted using Articulate Assistant Advanced. Finally, perception data is collected through a phoneme identification task with two phonetically trained L1 English listeners to examine whether the contrasts are perceivable.

The Z3-Z2 results show that four of five speakers show clear contrasts between English /l r/, with one speaker not producing a clear contrast between English /l r/ on this measure. As far as the Z3-Z2 measure is concerned, this could predict a smaller contrast in articulation in the latter speaker than in the former four speakers. I will discuss whether the above prediction holds by comparing tongue splines for the speakers who show little acoustic contrast with those who show a clear acoustic contrast and discuss which articulatory dimensions correspond with both acoustic contrast and listener perception.

References

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