Phonology **35** (2018). Supplementary materials

Assessing surface phonological specification through simulation and classification of phonetic trajectories

Jason A. Shaw
Yale University

Shigeto Kawahara
Keio University

Supplementary materials

Appendix A: A variant of H2

We consider a version of H2 in which the vowel target is not only reduced, but has greater variability than a regular vowel. We thank an anonymous reviewer for encouraging us to consider this possibility. What would the predictions of the classifier be for a situation in which the devoiced vowel was both reduced and highly variable? We investigated this possibility through simulation, gradually increasing variability of the reduced vowel and observing how the change in variability influences the distribution of posterior probabilities from the classifier. The results are shown in Fig. 14. (a) shows the result reported in Fig. 8 (H2). There is a monomodal distribution centred on a 0.5 probability of targetlessness. Each subsequent panel shows a distribution over posterior probabilities resulting from increased variance in the reduced vowel. (b) shows results when the reduced vowel is twice as variable as a full vowel, (c) triples the variance, and so on. We observe that, as variance increases, the posterior probabilities at the extreme ends of the scale, 0 and 1, also increase. This is because high variance makes extreme values more likely. At very high levels of variability, a trimodal distribution emerges, with peaks in the distribution around 0, 0.5 and 1.

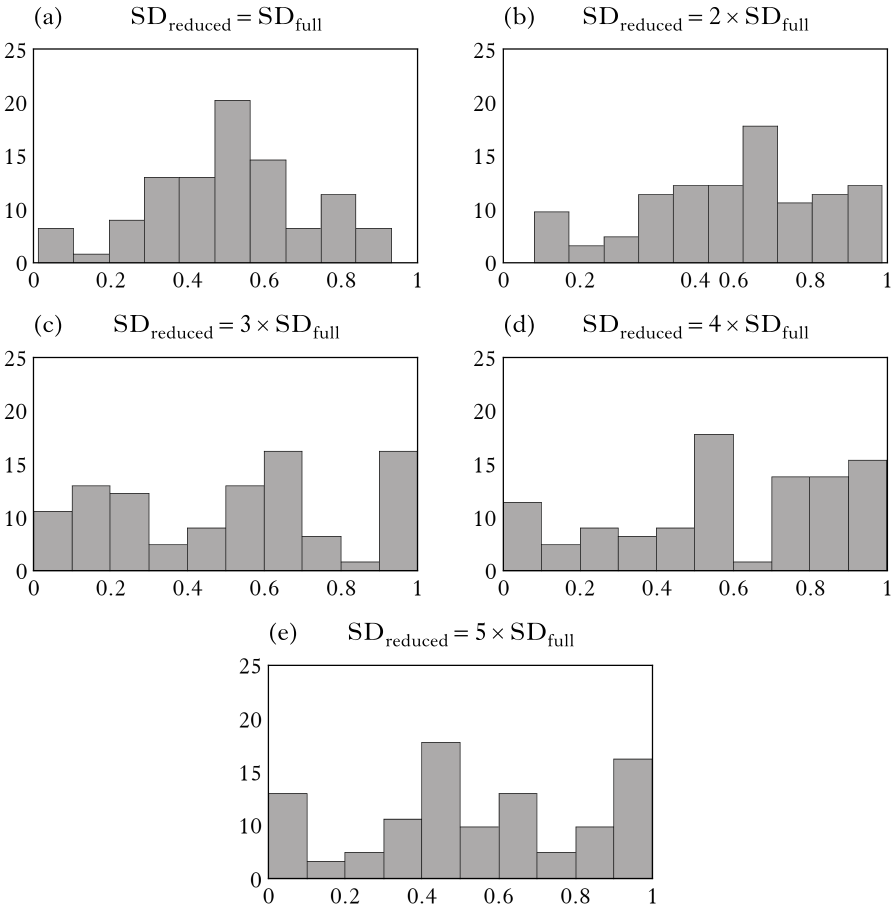

Figure 14

Increasing the inherent variability of reduced vowels for H2. (a) The level of variability of the reduced vowel is equal to the voiced vowel (cf. Fig. 8: H2); (b) the reduced vowel is twice as variable as the full vowel; (c) the reduced vowel is three times as variable as the full vowel; (d) the reduced vowel is four times as variable as the full vowel; (e) the reduced vowel is five times as variable as the full vowel.

Appendix B: Lip data

Strictly speaking, the analysis reported in the paper supports the optional absence of a vowel-height target in /u/, but we are not able to say with similar empirical robustness that the vowel is entirely absent, at least not from this analysis alone. Japanese /u/ is typically described as also having a labial specification, which involves lip compression (Vance 2008). Although we attached sensors to the vermillion borders of the upper and lower lips, and computed lip aperture as a function of time, this sensor configuration was unable to pick up lip compression even in voiced /u/ variants. Figure 15 shows representative data from speaker S1 for both dyads. The left side of the figure shows the /ɸusoku/ ~ /ɸuzoku/ dyad; the right side shows /ʃutaisei/ ~ /ʃudaika/. The panels show TD, TT, LA (lip aperture) and jaw height on the vertical axis, and time on the horizontal axis. For both dyads, the LA trajectory is consistent across the tokens with a voiced vowel (dashed lines) and the devoiced counterparts (solid lines). Both dyads show a gradual narrowing of the lips from /e/ in the carrier phrase to the onset of C_2, a coronal consonant in both cases. This time-course of LA narrowing corresponds with a gradual raising of the jaw to support coronal constrictions for C_2. In this data, we cannot identify a clear LA target for /u/, even in voiced environments. The lack of difference between voiced and voiceless environments in LA trajectories is not readily interpretable, as it is possible that the sensors on the vermillion borders of the lips were simply not able to pick up the lip-compression target. At this point, we are not able to rule out entirely that there is a residual labial specification for /u/, even when the vowel-height target is absent, but we direct interested readers to Shaw & Kawahara (2018b), who present some converging evidence for vowel absence based on analysis of the flanking consonants. They find that temporal reorganisation of C_1 and C_2 occurs in just those tokens that lack a vowel-height target.

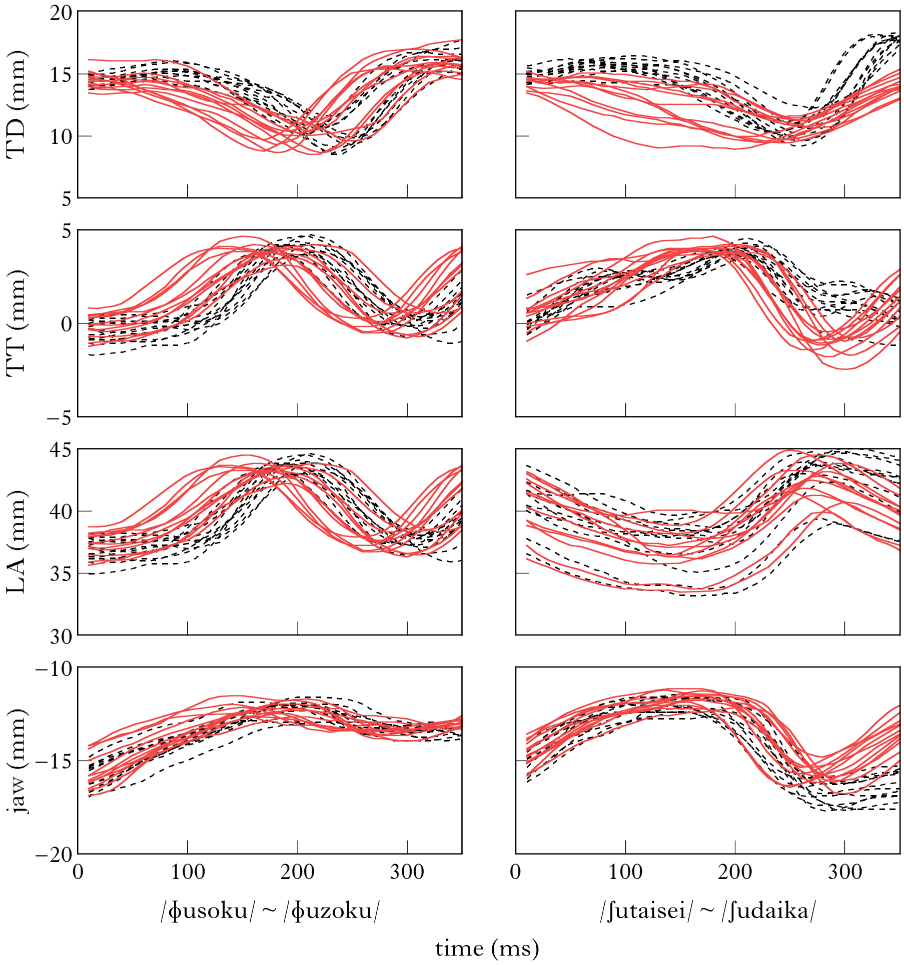

Figure 15

Articulatory trajectories for /ɸusoku/ ~ /ɸuzoku/ and /ʃutaisei/ ~ /ʃudaika/ dyads from one speaker. The trajectories begin with /e/, the vowel of the carrier phrase, and continue for 340 ms. The member of the dyad with a voiced /u/ is shown in dotted lines; the member with the voiceless vowel is shown in solid lines. Lip aperture (LA), shown in the third pair of panels, gradually narrows from /e/ to the coronal target for C_2, observable as a rise in tongue-tip height. This gradual narrowing of LA also corresponds to a gradual raising of the jaw, which also peaks at C_2. The continuity of the LA narrowing does not allow identification of LA targets for /u/ or even for /ɸ/.

ADDITIONAL REFERENCE

Vance, Timothy J. (2008). *The sounds of Japanese*. Cambridge: Cambridge University Press.