

Lingual articulatory evidence of Japanese devoiced vowels: /u/ still there?

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In Tokyo Japanese, high vowels (/i/ and /u/) are typically devoiced between voiceless obstruents. There is a controversy on whether devoiced vowels are (a) deleted entirely (i.e., there is no supralaryngeal vocalic gesture) or (b) merely unphonated (i.e., the vowel-specific gestures are retained). Various acoustic studies have shown coarticulatory effects of a devoiced vowel on the preceding consonant (C_1), indicating that the devoiced vowel is still present (e.g., Faber & Vance, 2000; Tsuchida, 1994; Whang, 2018). Articulatory evidence should confirm whether the following vowel would influence the lingual configuration of C_1 even when the vowel is devoiced. Previous work with /u/ in real words indicated the vowel is sometimes deleted (Shaw & Kawahara, 2018). Here, we use ultrasound to compare the tongue configuration of the release burst of /k/ between /ki/ and /ku/ in nonwords, including contexts in which the vowels are devoiced. Given that consonantal and vocalic gestures are in-phase (e.g., Goldstein, Byrd, & Saltzman, 2006), there should be some effects of the vowels on the tongue configurations of C_1 if devoiced vowels are merely unphonated. In contrast, the deletion of devoiced vowels would result in C_1C_2 coordination, which should mean that there is no effect of the devoiced vowels. We also examine whispered speech for comparison. The examination of the tongue configuration of /k/ can indicate whether devoiced vowels retain their lingual articulatory gestures.

Methods: Three native speakers of Tokyo Japanese produced nonce word pairs contrasting in the voicing realization of /i/ and /u/ (/kike/-/kige/, and /kuke/-/kuge/). They whispered /kige/ and /kuge/ as well. Tongue contours were traced from ultrasound frames corresponding to the moment of the release burst of the first /k/ (i.e., C_1). The comparison was made via smoothing spline ANOVA.

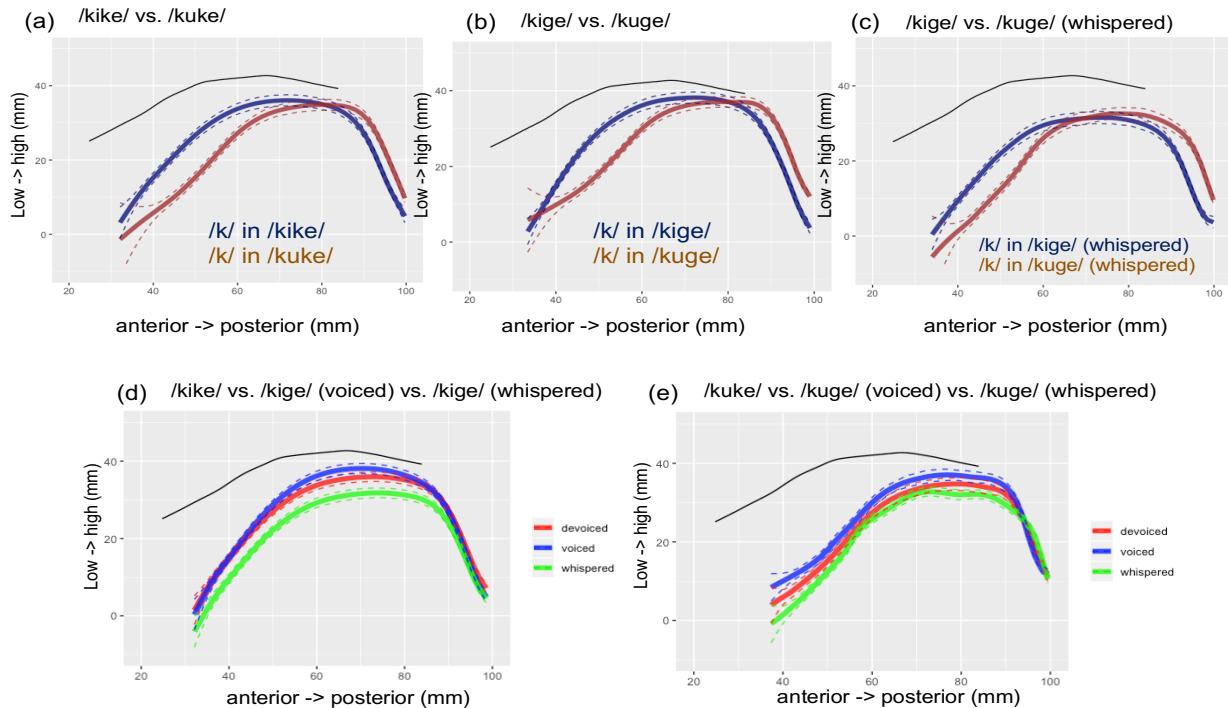
Results: The results from one speaker are shown in Figures 1 (the data from the other two will be analyzed by the time of the conference). The tongue configuration of the first /k/ consistently differed between /ki/ and /ku/ across the voicing realizations of the high vowel: The location of the constriction was more anterior when the following vowel was /i/. Within the word-pairs, the tongue configuration of /k/ was mostly the same whether C_1 preceded the devoiced or voiced high vowel. Whispered /k/ primarily showed lower tongue body than those produced in modal voice regardless of whether it preceded /i/ or /u/.

Conclusions: The coarticulatory effects of the following vowel on C_1 appear to be still present even when the vowel is devoiced. Further, the tongue configuration of /k/ was mostly the same regardless of the voicing realization of the following high vowel, implying that C_1V coordination is maintained when the vowel is devoiced. These two findings suggest that devoiced /i/ and /u/ in nonce words might retain their lingual articulatory gestures.

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Figures 1. Smoothing splines (solid lines) along with 95% Bayesian confidence intervals (dashed lines) of the tongue contour corresponding to the release burst of the first /k/ from one speaker; (a) the comparison between /kike/ and /kuke/ (i.e., when the high vowel was devoiced), (b) the comparison between /kige/ and /kuge/ (i.e., when the high vowel was produced with modal voice), (c) the comparison between whispered /kige/ and /kuge/ (i.e., when the whole word was whispered), (d) the comparison from the /ki/-pair, and (e) the comparison from the /ku/-pair. For (a)-(c), the cyan contours represent when /k/ was followed by /i/ while the brown contours do when /k/ was followed by /u/. For (d) and (e), red lines represent when the first /k/ preceded devoiced /i/ or /u/, blue lines represent when followed by voiced /i/ or /u/, and green lines show when whispered. In all, the black line represents the average palate trace for this speaker.

References

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