

## When long is tense and tense is long: An EPG study of Japanese and Korean stops

Recent phonetic studies of Japanese geminate obstruents revealed that these consonants do not simply differ from their singleton counterparts in duration, but are also characterized by lower F0, higher intensity, and some creakiness on adjacent vowels (Kawahara, 2006; Idemaru & Guion, 2008; Kawahara, to appear). Incidentally, similar acoustic correlates have been found to distinguish Korean obstruents, which involve fortis (tense), aspirated, and lenis (lax) categories (Cho et al., 2002). In particular, the greater creakiness of fortis segments has been attributed to their greater muscular tension both in the larynx and the oral cavity (Son et al., 2012). Articulatory studies of supralaryngeal gestures of these consonants showed that they are articulated with a tighter constriction, as well as longer duration, compared to aspirated and especially lenis stops (Cho & Keating, 2001; Kim et al., 2006). Hypothesizing that the underlying source of non-durational acoustic differences in Japanese stops is essentially the same, we would expect geminate constrictions to be tighter than those of singletons (cf. Sakuma, 1929/1963). We would also expect voiced stops to have weaker constrictions and shorter duration compared to voiceless singleton and geminate stops, thus resulting in a 3-way contrast differentiated by tenseness and length similar to Korean.

To test this hypothesis we collected electropalatographic (EPG) data from 6 speakers of Japanese and Korean (3 each). EPG tracks the contact of the tongue with an artificial palate (custom-made for each participant) in time, providing a convenient way of examining the relation between the duration and degree of linguopalatal contact of coronal consonants. The speakers produced stops and affricates (Japanese /t/, t, d, tʃ, tʃ, dʒ/; Korean /t\*, t<sup>h</sup>, t, tʃ\*, tʃ<sup>h</sup>, tʃ/) in a combination of nonsense and real words of the type [ma\_a] (e.g. *matta*, *mata*, *mada*, etc.) presented in a carrier phrase. 12 repetitions of each word were elicited, resulting in 432 tokens in total (6 words \* 12 repetitions \* 6 speakers). Measurements involved segment duration and degree of contact at the point of maximum constriction.

The results revealed that, consistently with the hypothesis, Japanese geminate stops and affricates were more constricted (as well as expectedly longer) compared to voiceless, and particularly to voiced singletons. The overall relation between the 3 consonant sets was strikingly similar to the Korean laryngeal contrast (see Fig. 1). Importantly, for all Japanese and Korean speakers, the correlation between duration and degree of contact was significant ( $p < .001$ ) for both stops and affricates. This suggests that, similarly to Korean, articulatory tension plays an important role in the production of Japanese obstruent contrasts (cf. Sakuma, 1929/1963), raising questions about their possible alternative phonological interpretations.

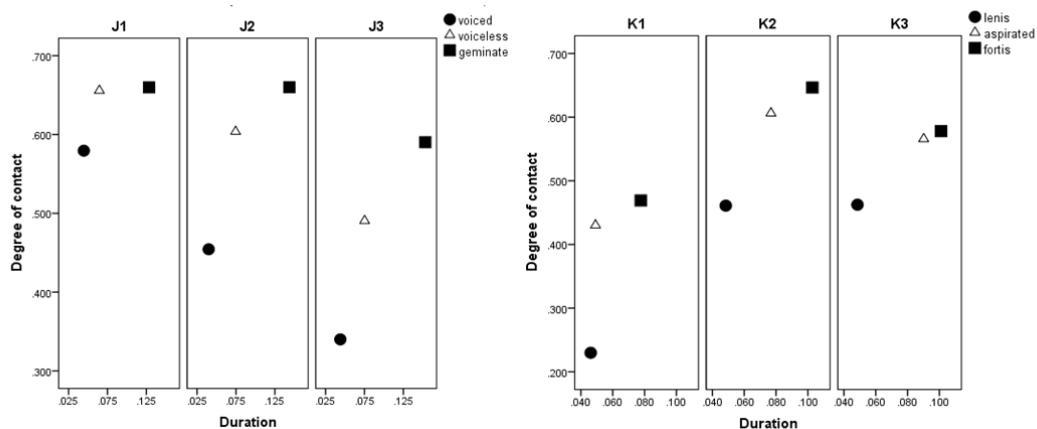


Figure 1. Degree of linguopalatal contact and closure duration (sec.) for Japanese /t/, t, d/ (left) and Korean /t\*, t<sup>h</sup>, t/ (right) in the context *ma\_a*, means for 3 speakers of each language.