A comparison of Mandarin and English palatal fricatives with articulatory data

Yung-hsiang Shawn Chang

National Taipei University of Technology (Taiwan)
shawnchang@mail.ntut.edu.tw

Mandarin palatals [ɕ, tɕ, tɕʰ] are post-alveolars or pre-palatals articulated with the blade or the anterodorsum of the tongue [1]. They are found to be among the most difficult consonants for second language learners (e.g., [2, 3, 4]). When taught to English-speaking learners, these three Mandarin consonants are often compared to English palatals /ʃ, dʒ, tʃ/, which are traditionally described as labialized palato-alveolars produced with the front of the tongue [5]. These comparisons, however, have resulted in different pedagogical suggestions. Chin [2] argued that, in teaching, the distinction of these two palatal series should focus on the height of tongue front. Li [6] and Lin [4], on the other hand, suggested that the Mandarin palatals can be taught as their English counterparts *with spread lips.* The current study sought to resolve these discrepant pedagogical solutions, potentially due to the researchers citing articulatory descriptions from different sources, by conducting a detailed comparison of the articulations of Mandarin and English palatals (specifically, palatal fricatives) with ultrasound tongue imaging, linguographic, palatographic, and lip video data.

The stimuli included Mandarin [ɕi, ɕa, ɕoʊ] carrying Tone 4, English /ʃi, ʃa, ʃo/, and non-palatal-initial syllables serving as distractors. All the stimuli were real words. Four native Taiwan Mandarin speakers participated in the experiment. For data collection through the ultrasound and lip camera, the participant wore a head stabilizer, to which the ultrasound transducer, lip camera, and head-mounted microphone were attached. The stimuli were randomized and repeated four times in isolation. Palatographic and linguographic data were collected following [7]. The stimuli were read once in isolation for palatography and linguography respectively. All English productions were verified by two native English listeners to be highly accurate.

The ultrasound data showed that three out of the four subjects' tongue shapes of Mandarin [ɕ] and English /ʃ/, across all three vowel contexts, were nearly identical. One subject (S01) seemed to distinguish the two articulations, in that his Mandarin [ɕ] had a slightly higher and more fronted tongue front than English /ʃ/ (see Figure 1) (cf. Mandarin [ɕ] having considerable raising of the tongue front than English /ʃ/ in [8]. Palatographic and linguographic data confirmed that the three subjects had similar lingual and palatal contact locations for [ɕ] and /ʃ/—laminal post-alveolars. S01's palatograms of [ɕ] (see Figure 2) showed that the narrowest constriction channel for [ɕ] fell within the denti-alveolar region. On the other hand, the constriction channel of S01's /ʃ/ was mainly in the alveolar area. S01's linguograms showed that the lateral contacts of [ɕ] and /ʃ/ on the tongue body were similar, with the narrowest part of the constriction channel being on the blade. Therefore, S01's [ɕ] should be a laminal denti-alveolar, whereas his /ʃ/ was a laminal alveolar. Lip video data showed that for all four subjects the horizontal lip distance between the /ʃ/ production and the resting state was significantly greater than that between [ɕ] and the resting state (see Figure 3 for S01's lip data), indicative of robust lip protrusion in /ʃ/. Taken together, the preliminary findings of this study suggest that the primary and consistent feature distinguishing between Mandarin [ɕ] and English /ʃ/ is lip rounding, instead of lingual and palatal contact locations. These results therefore support [4] and [6]'s assertion that, in pedagogical practices, Mandarin [ɕ] can be considered to be an English /ʃ/ without lip rounding.
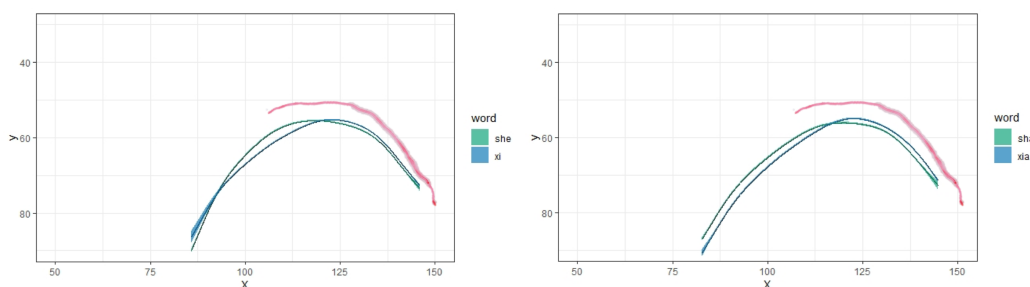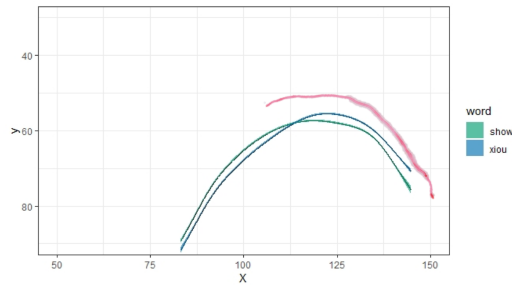
Fig.1 Tongue shapes of [ɕ] and /ʃ/ for S01 (the right side of the image is anterior; palatal contour is traced in red)

Fig.2 S01's palatograms and linguograms (upper panel: [ɕi, ɕa, ɕo]; lower panel: /ʃi, ʃa, ʃo/)
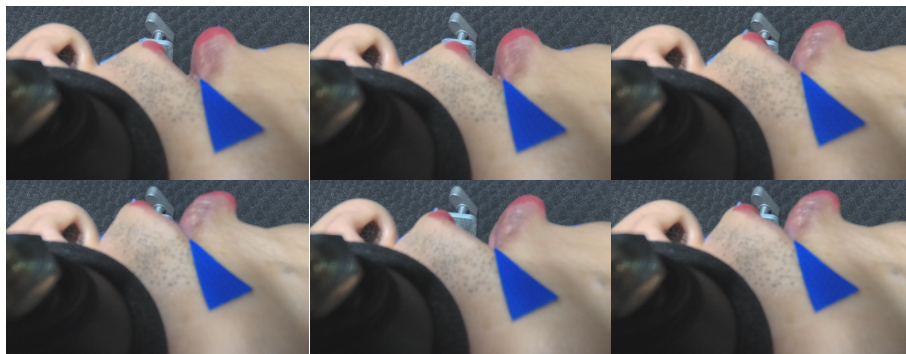

Fig.3. S01's lip images of [ɕi, ɕa, ɕo] (upper panel) and /ʃi, ʃa, ʃo/ (upper panel)

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