An articulatory investigation of Mandarin speakers’ production of English /r/
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Background
The influence of L1 sounds on the learning of L2 sounds
• Given that Mandarin /ɻ/ and English /r/ are perceptually similar and share similar phonological distribution (Lin 2007), Chen & Mok (2019) investigated whether Mandarin-English bilinguals would produce a merged category or distinct phonetic realizations for the two /r/s, and found that their proficient bilingual speakers realized the two /r/s differently in both acoustics and articulation.

Research question 1: Is English /r/ in less proficient L2 learners more likely to undergo equivalence classification with the Mandarin /ɻ/ (i.e., L2 /r/ being assimilated into Mandarin /ɻ/)?
• Given that /ɻ/ in Taiwan Mandarin has four different realizations: [ɻ, z, ʐ, l] (Chuang & Fon 2015), it offers an opportunity to test whether a new phonetic category is more likely to be established when an L2 sound is phonetically different from the closest L1 sound

Research questions 2: Are Taiwan speakers with [ɻ, z, ʐ, l] productions for Mandarin /ɻ/ more likely to produce a separate phonetic category for English /r/ than those with the [ɻ] realization?
• The research questions were formulated to test the hypotheses in Flege’s (1995) Speech Learning Model.

Methods
Instruments
To examine articulations of L1 Taiwan Mandarin /ɻ/ and L2 English /r/, this study used:
• ultrasound tongue imaging (tongue shape)
• linguography (point of constriction on the tongue)
• palatography (place of articulation)
• lip imaging (lip protrusion)

Stimuli
Mandarin row (ɹ, ř), ru (ɹː), rui (ɾuí) and English row, rue, ray, as well as non-/r/-initial CV syllables serving as distractors. All the stimuli were repeated 5 times.

Participants
6 native Taiwan Mandarin speakers (3 M, 3 F) with intermediate-level proficiency in English (as measured by their TOEIC scores).

Screening
• Mandarin /ɻ/ tokens were categorized into [ɻ, z, ʐ, l] based on 2 phonetically trained research assistants’ auditory impression.
• English /r/ tokens were correctly identified and rated 3 or above on a 5-point Likert scale by 2 native English speakers.

Results

• Pattern 1—a merged L1-L2 category (3 subjects): Subject 6 (see Figure 1) produced an apical post-velar retroflex /ɾ/ for both Mandarin and English, with no lip protrusion difference.

• Pattern 2—distinct L1-L2 categories (1 subject): Subject 1 (see Figure 2) produced an upperapical pre-palatal retroflexed approximant for Mandarin /ɻ/, but a laminal palatal bunched approximant for English /r/.

• Pattern 3—emerging L1-L2 category dissimilation (2 subjects): While Subject 3 (see Figure 3) did not differentiate the two /r/s in all of our articulatory measurements—both involved the blade of the tongue (with a bunched tongue shape) approximating the post-alveolar region, with no significant lip protrusion difference, she realized Mandarin /ɻ/ as a fricative [ɻ] and English an approximant /r/.

In comparison to Chen & Mok’s (2019) advanced bilingual speakers, the current study found half of the less proficient L2 speakers produced the L2 /ɾ/ with reference to their L1 /ɻ/; L2 proficiency may be critical to L2 category assimilation vs. dissimilation.

Individuals with [ɻ, l] realizations for Mandarin /ɻ/ produced an approximant /ɾ/ for English that shared the same articulatory configurations as the Mandarin /ɻ/→L1-L2 phonetic dissimilarity is not necessarily more likely to result in a new L2 category.