Enhancement of sibilant contrasts during word processing by Mandarin-Min bilinguals

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Once phonemic categories are merged, the reversal of the merger is known to be nearly impossible by linguistic means [3]. In the cases of near-merger, however, speakers may make subtle but consistent production differences even when the differences are not perceptible [8], and mergers could be less merged during spontaneous phonetic imitation driven by social preferences [4]. The present study explores the nature of sibilant merger implemented by Mandarin-Min bilingual speakers in Taiwan. Taiwanese Southern Min (TSM) lacks retroflex sibilants in the system, and speakers of Taiwan Mandarin (TM) tend to show alveolar-retroflex sibilant merger primarily through deretroflexion [2]. The merger is reported to be incomplete articulatorily [6], and we demonstrate the conditions in which the weak contrast is fully realized, reflecting the actual mental representations stored in the mind of the speaker.

Forty Taiwanese college students (20F, 20M) participated in two sets of production experiments. Half of the participants self-identified as TSM-fluent ($M = 5.90/7$), and the other half as TSM-weak ($M = 1.65/7$). In a priming study, experimental stimuli included frequency-matched disyllabic Mandarin words containing all six word-initial sibilants (alveolars /s ts tsʰ/ vs. retroflexes /ʂ tʂ tʂʰ/). Target words were paired with either congruent (homophones) or incongruent primes (minimal pairs differing in sibilant place) (Table 1). The priming study was carried out using a backward-masked word-naming paradigm: prime (50 ms), mask (#######, 50 ms), and then naming of the target item. For the reading task, a new set of stimuli was used containing sibilants in phonologically balanced contexts but without any minimal pairs. Participants read aloud the stimuli that appeared on a computer screen in a carrier sentence. All the stimuli in both studies were presented visually in Chinese characters which are logographic and do not carry any phonological information.

For the data from the reading task, two native TM speakers classified target retroflex tokens as either alveolars (merger) or retroflexes (non-merger). Three separate groups were identified based on the ratio of deretroflexed sibilants: MERGER (11F&10M, > 2/3), INTERMED (3F&4M, 2/3~1/3), and CONTRAST (6F&6M, < 1/3). Interestingly, many TSM-weak speakers (8/20) merged sibilants, indicating that the merger does not necessarily arise from direct contact with TSM—the pattern has become widespread among the speech community in Taiwan. Next, the results of the multitaper spectral analyses of the frication noise and subsequent mixed-effects regression analyses revealed two prominent patterns. First, speakers in all three groups enhanced the contrast to a greater degree during priming than during reading (spectral difference: M(reading) = 1,243 Hz vs. M(priming) = 2,458 Hz) (Figure 1). Second, male MERGER speakers merged the contrast the most during reading (M(spectral difference) = 423 Hz), but they also enhanced the contrast the most when primed with incongruent primes (M = 1,991 Hz). This was achieved primarily via prime-target dissimilation: alveolars became more *alveolarized* (higher spectral mean) when primed with *retroflexes*, whereas retroflexes became more *retroflexed* (lower spectral mean) when primed with *alveolars* (Figure 2).

The differences driven by the experimental tasks can be attributed to the minimal pair primes available only in the primed production, echoing the findings of production studies which have shown that minimal pair competitors enhance the contrast [1, 7]. Further, compared with female speakers, male speakers implemented the merger to a greater degree, perhaps due to the relative freedom from social pressure to conform to prestigious standard Mandarin associated with full retroflexion [5]. Nonetheless, male MERGER speakers demonstrated robust contrasts during subliminal priming. The results indicate that while the merger may be modulated by social factors, abstract representations persevere in the minds of individual speakers.

Table 1. Examples of experimental stimuli.

Congruent prime	Target	Incongruent prime	Target
站立	戰力	自立	智利
/**tʂ**an^{51} li^{51}/	/**tʂ**an^{51} li^{51}/	/**ts**i^{51} li^{51}/	/**tʂ**i^{51} li^{51}/
'stand still'	'combat capability'	'self-reliance'	'Chile'
retroflex	retroflex	**alveolar**	**retroflex**
司儀	私誼	山腳	三角
/**s**i^{55} i^{35}/	/**s**i^{55} i^{35}/	/**ʂ**an^{55} tɕiao^{214}/	/**s**an^{55} tɕiao^{214}/
'show host'	'personal relationship'	'hillside'	'triangle'
alveolar	alveolar	**retroflex**	**alveolar**
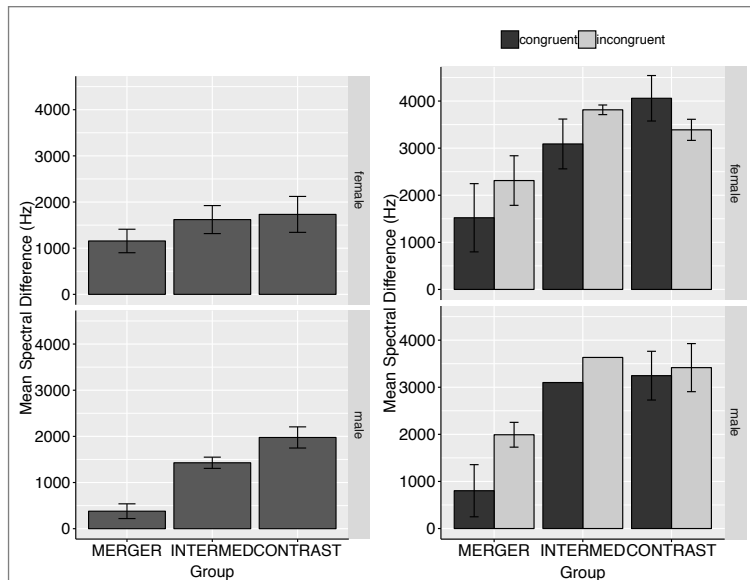
Figure 1. Mean spectral distance (*M*(alveolar)-*M*(retroflex)) by experimental task: read speech (left) vs. primed production (right).
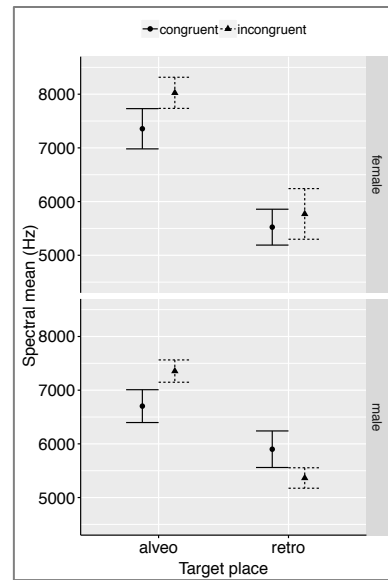
Figure 2. Spectral mean by MERGER speakers during priming

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