Enhancement of sibilant contrasts in near merger during word processing by Min-Mandarin bi-dialectal speakers

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Many Chinese dialects including Southern Min lack retroflex sibilants in the system. Accordingly, bi-dialectal Min-Mandarin speakers in Taiwan tend to show dental-retroflex sibilant merger conditioned by multiple factors. For example, Shih [3] demonstrated young adults convey a more distinctive Mandarin three-way sibilant contrast (dental, retroflex, alveopalatal) compared to older generations. Chuang and Fon [2] showed merger is further conditioned by gender, region, and the frequency of the use of Min. The lack of sibilant contrasts by those bi-dialectal speakers may have significant consequences in word processing. Wu and Ma [4], for example, have shown that early Hakka-Mandarin bilinguals demonstrated a sign of automatic phonological activation of both lexical items containing dental and retroflex sibilants, leading to a significant delay in word processing. The present study explored the nature of sibilant merger implemented by young bi-dialectal speakers in Taiwan using varying experimental paradigms.

First, a reading task was conducted to examine participants' regular sibilant production. This task included a set of disyllabic stimuli with all six sibilants (dentals /s ts tsh/ vs. retroflexes /ʂ tʂ tʂh/) in word-initial position. Forty college students in total were recruited and divided into three groups based on whether they conveyed clear retroflexes in contrast to dentals in their production: Merger (11F/10M), Intermediate (3F/4M), and Contrast (6F/6M) groups. Sibilant merger among young speakers was more gradient than previously assumed. The intermediate group, in particular, singled out the speakers who variably conveyed the contrast: approximately half of the stimuli carried the contrast, while the other half showed merger.

In a priming study, experimental stimuli included disyllabic Mandarin compounds containing word-initial sibilants as well as many filler items. The target words were paired with either congruent (/**tʂ**an^{51}li^{51}/ 'stand still' – /**tʂ**an^{51}li^{51}/ 'combat capability'; /**s**i^{55} yi^{35}/ 'master of ceremonies' – /**s**i^{55} yi^{35}/ 'personal relationship') or incongruent primes (/**ts**i^{51}li^{51}/ 'self-reliance' – /**tʂ**i^{51}li^{51}/ 'Chile'; /**ʂ**an^{55} jiao^{214}/ 'hillside' – /**s**an^{55} jiao^{214}/ 'triangle') (Table 1). The word frequencies were matched across conditions using Academia Sinica Balanced Corpus of Modern Chinese. A word-naming study was carried out in e-prime designed in a backward masked prime paradigm. After a fixation cross, a brief prime (50 ms) was presented followed by a 50 ms mask (#######) on a computer screen. A target item then appeared on the screen for three seconds. Upon seeing the target, participants were asked to read aloud the target as quickly and accurately as possible. All the stimuli in both studies were presented visually in Chinese characters which are logographic and do not carry phonological information of the words.

Table 1. Examples of experimental stimuli.

Congruent prime	Target	Incongruent prime	Target
站立 'stand still' /**tʂ**an^{51} li^{51}/	戰力 'combat capability' /**tʂ**an^{51} li^{51}/	自立 'self-reliance' /**ts**i^{51} li^{51}/	智利 'Chile' /**tʂ**i^{51} li^{51}/
retroflex	retroflex	**dental**	**retroflex**
司儀 'show host' /**s**i^{55} yi^{35}/	私誼 'personal relationship' /**s**i^{55} yi^{35}/	山腳 'hillside' /**ʂ**an^{55} jiao^{214}/	三角 'triangle' /**s**an^{55} jiao^{214}/
dental	dental	**retroflex**	**dental**

The frication noise during the primed sibilant production was annotated and submitted to a time-averaging spectral analysis. The distribution of CoG (Center of Gravity) values was summarized in

Figure 1. Overall, the CoG distance between dental and retroflex sibilants (ΔCoG) was the smallest for the Merger group (1,465 Hz), followed by Intermediate (2,300 Hz), and the largest for the Contrast group (2,957 Hz). Within the Merger group, male speakers were more likely to merge sibilants than females (ΔCoG(male)= 1,116 Hz, ΔCoG(female)= 1,783 Hz), similar to the findings in Chuang and Fon (2010). Nevertheless, the Merger group showed small but consistent spectral differences between dentals and retroflexes, suggesting a contrast in near merger, not complete neutralization [5]. Further, the results generally showed dissimilation of the sibilant targets from the incongruent primes: dentals become more *dentalized* (higher CoG) when primed with *retroflexes*, whereas retroflexes become more *retroflexed* (lower CoG) when primed with *dentals*, resulting in the enhancement of the dental-retroflex contrast. This pattern was most evident for the male speakers in the Merger group (ΔCoG(Congruent)= 513 Hz vs. ΔCoG(Incongruent)= 1,938 Hz), as verified by a significant interaction between TargetPlace and PrimeType (p =.016). Despite some trend, the interactions were not significant for other groups.

Taken together, the results suggest that the speakers showing dental-retroflex near merger, in fact, have fully distinct representations of the contrasting sibilants, which may be implemented explicitly when primed with directly contrasting sounds. In a formal read speech, however, the contrast may remain covert – being realized as near merger – presumably due to the social prestige associated with non-full-retroflexion for the retroflex sibilants in Taiwan [1].
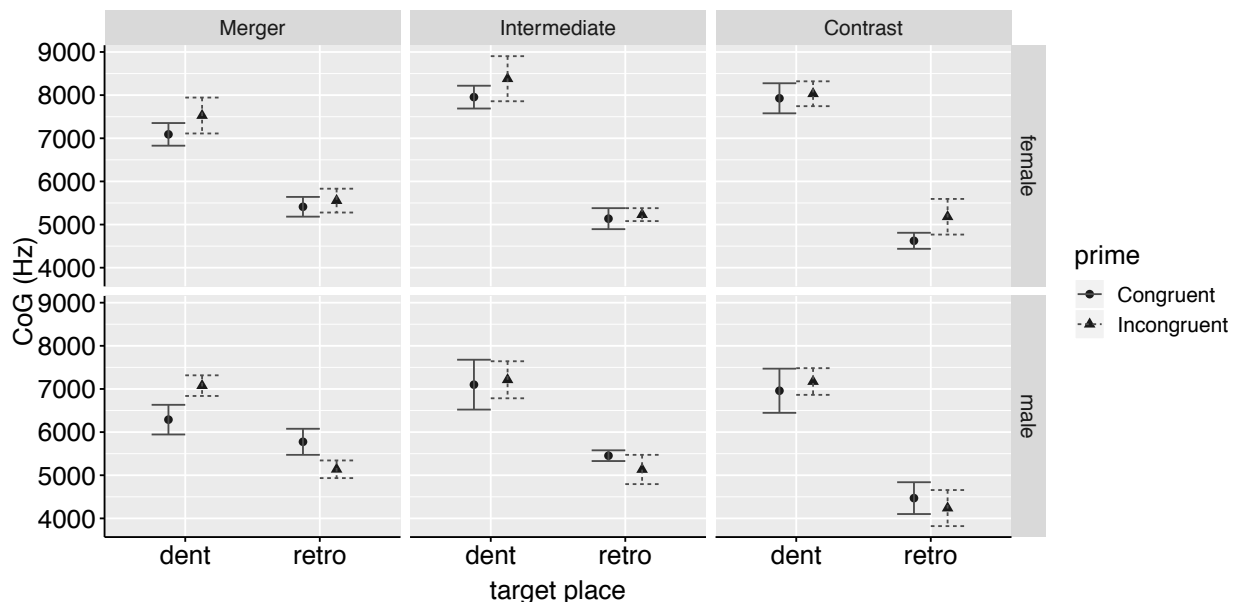

Fig 1. Mean CoG values (Hz) of the target sibilants presented with congruent vs. incongruent primes. Participants were divided into three groups based on whether they conveyed sibilant contrasts in the regular reading task.

References
[1] Chung, K. S. (2006). Hypercorrection in Taiwan Mandarin. *Journal of Asian Pacific Communication,* 16(2), 197–214.
[2] Chuang, Y. Y. & Fon, J. (2010). The effect of prosodic prominence on the realizations of voiceless dental and retroflex sibilants in Taiwan Mandarin spontaneous speech. *Proceedings of the 5th International Conference on Speech Prosody*.
[3] Shih, Y. T. (2012). Taiwanese-Guoyu bilingual children and adults' sibilant fricative production patterns. Doctoral dissertation, The Ohio State University.
[4] Wu, S. & Ma, Z. (2017). Native-language phonological interference in early Hakka–Mandarin bilinguals' visual recognition of Chinese two-character compounds: Evidence from the semantic-relatedness decision task. *Journal of Psycholinguistic Research*, 46 (1), 57–75.
[5] Yu, A. (2005). Understanding near mergers: the case of morphological tone in Cantonese. *Phonology*, 24, 187–214.