

Tonal Coarticulation in Taiwan Mandarin and Taiwan Southern Min

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Background Tonal coarticulation has been found to have an asymmetric distribution, with carry-over effects being stronger than anticipatory ones, and with the former being assimilatory and the later dissimilatory, as reported in a number of tonal languages, such as Beijing Mandarin, Cantonese, Thai, and Vietnamese [1]. Some inconsistent results, however, have been found in languages like Taiwan Southern Min and Malaysian Hokkien, where the two languages were found to have more symmetric distributions [1,2]. This raises the question as to whether tonal coarticulation is a universal constraint applied to all tone languages, or can be voluntarily controlled. Several scholars support the first stance, contending that tone variation under coarticulation is likely caused by articulatory constraints (e.g., [3]). Some findings, on the other hand, point to the possibility that such variation may be manipulatable (e.g., [4]). A comparison between Taiwan Mandarin and Taiwan Southern Min is therefore a good testing ground for the two theories. On one hand, Taiwan Mandarin, as Beijing Mandarin, only has four lexical tones, and therefore is likely to have strong tonal coarticulation; on the other hand, Taiwan Southern Min has a much larger tone inventory, where the same amount of tonal coarticulation would lead to higher risk of perceptual confusion, which presumably would be avoided if it is indeed manipulatable. Otherwise, tonal coarticulation is likely not entirely voluntary.

This study thus aims to measure and compare coarticulatory effects in the two languages and to provide insights concerning the nature of tonal coarticulation.

Methods A production experiment was conducted to examine tonal coarticulation in Taiwan Mandarin and Taiwan Southern Min. The experiment quantified both carry-over and anticipatory effects in disyllabic words.

Participants & stimuli This study recruited 25 Taiwanese college students as participants (15 females; 20–27 y.o., mean=22.64), including 14 Taiwan Mandarin monolingual and 11 Taiwan-Mandarin-Taiwan-Southern-Min bilingual. The monolingual speakers produced only Taiwan Mandarin stimuli while the bilingual speakers produced both the Taiwan Southern Min and Taiwan Mandarin stimuli. A disyllabic word was chosen for each of the 16 (4 tones×4 tones, for Taiwan Mandarin) and 25 (5 tones×5 tones, for Taiwan Southern Min, with the two check tones excluded) tone combinations as stimuli. Each word was produced 10 times.

Pitch extraction F0 values were extracted using Praat [5], with the time step set at 0.01s. The F0 values were divided into 11 proportions, and the mean of the F0 values in each proportion was calculated, and then converted to z-transformed semitones for between-subject comparisons.

Analyses To quantify the magnitude of tonal coarticulation, pitch onsets and offsets were obtained, determined by the F0 means of the first and last 11 time points from each tone production. To compare Taiwan Mandarin and Taiwan Southern Min, realized tones after sandhi were converted into a five-level scale. The F0 values were then fitted through linear mixed effect models (LMM). In this study, a positive coefficient is regarded as indicator of assimilatory effects, and vice versa.

Results & discussion The results are shown below in Fig. 1. Significant coarticulatory effects were found for both carry-over and anticipatory effects (all $p < .001^{***}$), and no differences of magnitudes of coarticulatory effects between Taiwan Mandarin and Taiwan Southern Min were found, be it carry-over or anticipatory ($p = .31$ and $p = .65$, respectively). Contra previous findings in Beijing Mandarin, Taiwan Mandarin had more symmetric distribution, with both carry-over and anticipatory effects being assimilatory. No differences were found between the Mandarin results of monolingual and bilingual speakers ($p = .92$ and $p = .19$, carry-over and anticipatory, respectively). The results in our study seem to support the view of [3] and others, which suggests that tonal

coarticulation is likely to a large extent involuntary. As argued previously, for a language such as Taiwan Southern Min, with its large tone inventory, to have the same amount of tone variation as Taiwan Mandarin would mean that perception in continuous speech can be more challenging, as the odds of confusing a coarticulated tone with another lexical tone are bound to be higher. The fact that the magnitudes of coarticulatory effects in the two languages are not different suggests highly that such variation is likely not entirely voluntary.

It is, however, interesting to note that discrepancies indeed were found between Beijing Mandarin and Taiwan Mandarin, with the later having typologically more singular symmetric distribution just as Taiwan Southern Min. One possible explanation is that Taiwan Mandarin, as a more syllable-timed language than Beijing Mandarin, could have more even emphasis on the former and the later syllables, resulting in the more symmetric distribution of tonal coarticulation attested. Further investigation is required to test such theory.

Overall, this study investigated tonal coarticulation in Taiwan Mandarin and Taiwan Southern Min, finding that both languages, despite the large size difference of tone inventory, had similar amount of tone variation under coarticulation. This study is the first to investigate tonal coarticulation in Taiwan Mandarin, and to quantitatively compare coarticulated tones in two languages with different sizes of tone inventory. We hope to provide novel perspectives concerning the nature of coarticulation and tone variation.

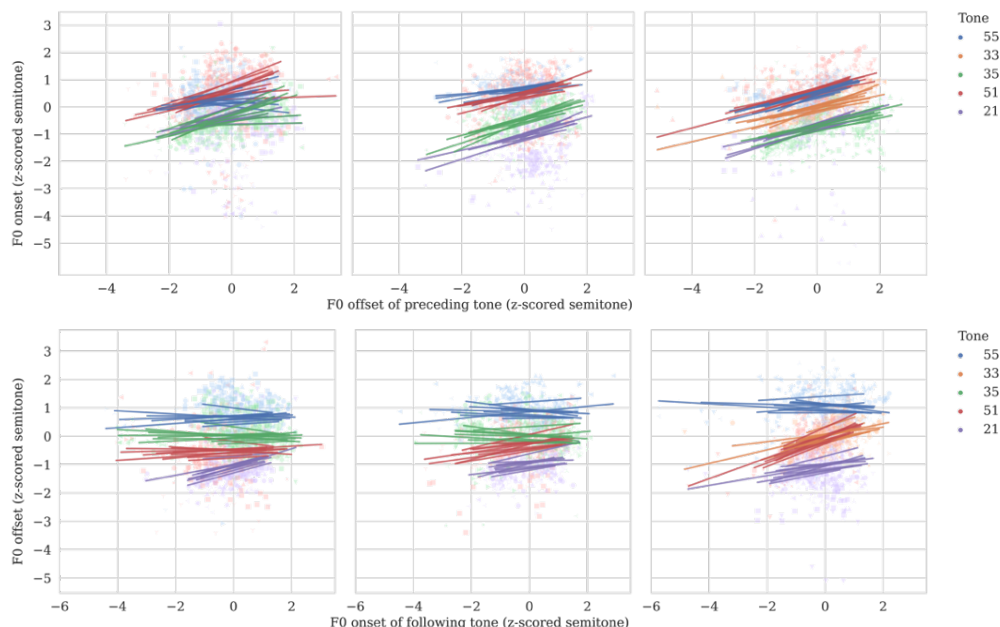


Fig. 1: Fitted LMM models of tone onsets and offsets in carryover (top) and anticipatory (bottom) positions (left: Taiwan Mandarin (monolingual); middle: Taiwan Mandarin (bilingual); right: Taiwan Southern Min)

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