

The impact of sound change on checked tone perception in Taiwanese Southern Min

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Taiwanese Southern Min (TSM) features five unchecked tones and two checked tones. The two checked tones, T5 and T3 (with numbers specifying pitch height), occur with closed CVC syllables, that end in voiceless unreleased stops [p, t, k, ʔ] while the five unchecked tones (T55, T13, T51, T31, and T33) are associated with CV(N) syllables [1]. Besides segmental differences, short duration, glottalization, and formant transitions into the coda also characterize checked TSM tones. [1] reported that TSM checked tones are undergoing a sound change involving coda deletion (see also [2]), with the dropping rate ranking as [ʔ] > [k] > [t] > [p]. Due to this ongoing sound change, listeners may rely on vowel duration to distinguish checked and unchecked tones. [3] examined the role of duration in distinguishing checked and unchecked tones for the most deleted coda type /ʔ/. Their findings indicated that duration served as a reliable cue in the mid tonal register. Building upon their research, the current study expands the investigation to include three additional coda types, /p/, /t/, and /k/. It not only examines the role of duration and final stop information in the checked vs. unchecked contrast but also explores how listeners rely on these two cues in relation to the varying deletion rates of the three coda types in production. This exploration aims to shed light on the TSM checked tone sound change.

To examine the perception of checked vs. unchecked contrast, we conducted a 2AFC identification task with 20 TSM speakers (9 M; mean age: 23.75). The experiment utilized stimuli consisting of three types of 8-step continua, which were manipulated from 12 recorded target syllables with a fixed Ci(C) syllable (e.g., /tit/T5 ‘straight’; /ti/T55 ‘pig’). In the Checked and the Unchecked continua, we manipulated the duration of the target syllable using PSOLA in Praat [4], lengthening it from 100 ms to 310 ms with an interval of 30 ms for the Checked continua and shortening it for the Unchecked continua. That is, the Checked continua were created by lengthening the checked sample tokens, while the Unchecked continua were created by shortening the unchecked sample tokens. As a result, final stop information was exclusively presented in the Checked continua. The short endpoint of the Checked continua and the long endpoint of the Unchecked continua then served as the two endpoints of the third type of continua, the All-cue continua. For the All-cue continua, all contributing cues, including duration cue and final stop information, were proportionally manipulated using Tandem-straight [5]. It is important to note that the stimuli in our research, encompassing the Mid and High tonal registers, differ solely in pitch, with the spectrum of the tokens in High register replaced by those in the Mid register.

The results (Fig. 1) indicate the absence of categorical perception in Mid/High Checked and Mid/High Unchecked continua, suggesting a more significant role of final stop information compared to duration in the perception of checkedness in TSM. Despite the possibility of coda consonant deletion in the production of TSM checked tones [6], final stop information still strongly influences the perception of TSM checked tones in the current state. One possible explanation is that the perceptual input for these young TSM listeners is primarily influenced by the older generation, which preserves the coda consonant in their production of checked tones. As a result, the perception of the young TSM listeners becomes disconnected from their own production, where coda deletion is a prevailing trend. However, in our result, both registers still exhibit a significant duration effect. Except for the coda type /k/, the pattern observed in the High register aligns with the ranking of coda deletion rate (/k/ >) /t/ > /p/. The weak duration effect of coda type /k/ can be attributed to the high saliency of the vowel transition cue in its stimuli (Fig. 2, boxed panel). Although the participants generally relied more on the final stop information than the duration cue in perceiving checkedness in TSM, the stronger role of vowel duration in coda type /t/ compared to coda type /p/ suggests an increasing role of duration in the checked vs. unchecked contrast in TSM under sound change. Theoretical implications of cue trading and perception-production dis-link in sound change will be discussed.

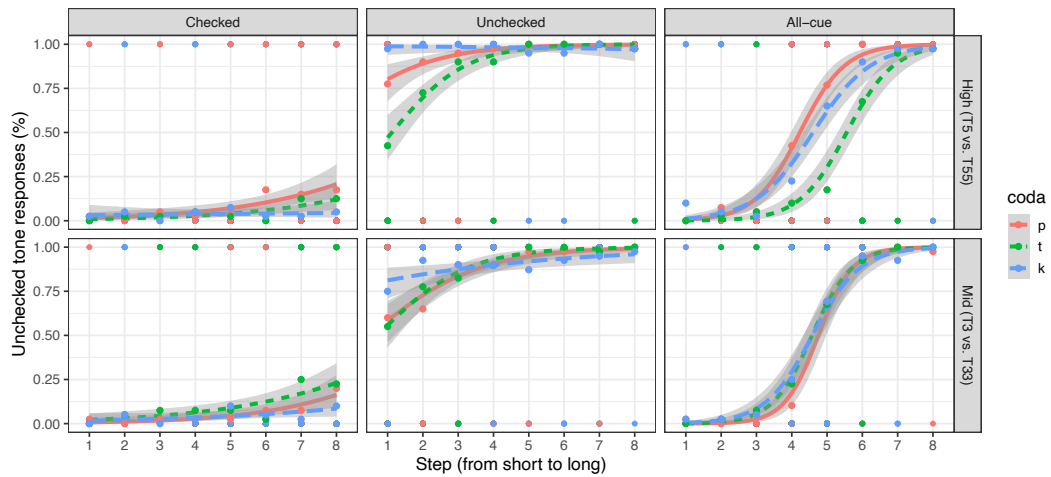


Fig. 1: Tonal categorization result: Red solid lines= /p/, Green dotted lines= /t/, Blue dashed lines= /k/. Rows: High register (top), Mid register (bottom). Columns: Checked (left), Unchecked (middle), All-cue (right).

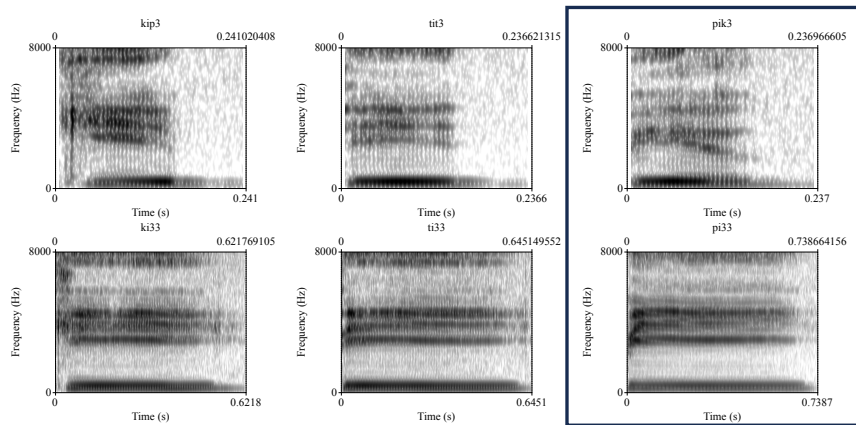


Fig. 2: Spectrograms of the sample tokens in Mid register. Rows: checked (top), unchecked (bottom). Columns: coda type /p/ (left), coda type /t/ (middle), coda type /k/ (right). (All the selected target syllables have the same nucleus, a high front vowel /i/.)

Selected References

- [1] Pan, Ho-hsien. (2017). "Glottalization of Taiwan Min checked tones." *Journal of the International Phonetic Association* 47.1: 37-63.
- [2] Weng, W.-C., & Lee-Kim, S.-I. (2023). Loss of unreleased final stops among Mandarin-Min bilinguals: Structural convergence of languages in contact. *Journal of Phonetics*, 101, 101279.
- [3] Zhang, Wei, & Lu, Yu-An. (2023). The Role of Duration in the Perception of Checked versus Unchecked Tones in Taiwanese Southern Min. 20th ICPHS, Prague, Czech Republic.
- [4] Boersma, P. (2008). Praat: doing phonetics by computer (version 5.0. 25). <http://www.praat.org/>.
- [5] Kawahara, H., Morise, M., Takahashi, T., Nisimura, R., Irino, T., & Banno, H. (2008, March). Tandem-STRAIGHT: A temporally stable power spectral representation for periodic signals and applications to interference-free spectrum, F0, and aperiodicity estimation. In *2008 IEEE International Conference on Acoustics, Speech and Signal Processing* (pp. 3933-3936). IEEE.
- [6] Pan, Ho Hsien, and Shao Ren Lyu. (2021). "Taiwan Min Nan (Taiwanese) checked tones sound change." *22nd Annual Conference of the International Speech Communication Association, INTERSPEECH 2021*. International Speech Communication Association.