

The effect of lexicality, frequency and markedness on Mandarin tonal categorization

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With four lexical tones, there are around 1500 possible tone-syllable combinations in Mandarin (Lin, 2007). However, not all combinations are attested. Previous studies on Mandarin tonotactic accidental gaps (i.e., unattested tone-syllable combinations) have shown that falling T4 (X^{51}) gaps are more readily accepted as words than other gaps, while dipping T3 (X^{214}) gaps are rated as the least wordlike among all the tones (Jin & Lu, 2019). The general acceptance of T4 gaps was attributed to its high tone frequency (independent of syllable frequency) and the fact that the fewest gaps are observed for T4. The general rejection of T3 gaps was attributed to their marked tonal contour. While the Ganong lexicality effect (word vs. nonword) (Ganong, 1980) has been repeatedly observed for phonemic and tonal categorization (word vs. tonotactic accidental gap) (Fox, 1984; Yang, Jin, & Lu, 2019), the effects of frequency (e.g., Connine, Titone, & Wang, 1993; cf. Politzer-Ahles, Lee, & Shen, 2020) and markedness are less clear, especially in terms of tonal categorization. We investigate the effects of lexicality, tone frequency and markedness by examining Mandarin speakers' tonal categorization of tokens on all possible tonal continua with one end being a word and the other being a gap. We predict that the speakers' categorization will be biased away from the T3 endpoints but towards T4 gap endpoints.

A forced-choice identification experiment was conducted in which 22 Taiwan Mandarin speakers (13 female, 9 male, aged 20-28, $M=21.9$) were presented with items sampled from 10-step continua for the following tone pairs: T1-T2 (high-level X^{55} -rising X^{35}), T1-T3, T1-T4, T2-T3, T2-T4, T3-T4 (Fig. 1). Tokens were synthesized using Tandem-STRAIGHT (Kawahara et al., 2008). Continuum endpoints were either words or gaps (e.g., gap-word *T1-T3/word-gap T1-*T3; *[ny]⁵⁵-[ny]²¹⁴ 'woman'/[hy]⁵⁵ 'drink'-*[hy]²¹⁴). Participants were presented with each of the items randomly with the left endpoint tone (e.g., T1 on T1-T3 continua) and the right endpoint tone (e.g., T3 on T1-T3 continua) shown on the computer screen and were asked to indicate which tone they heard on a keyboard.

The preliminary results showed a general bias against the gap endpoints (Fig. 2, solid lines vs. dotted lines), as has been previously reported (Fox, 1984; Jin & Lu, 2019), with the noted exception of those continua involving T4. Specifically, when T4, the most frequent tone, served as the gap endpoint, no obvious bias against it was observed (Fig. 2, T1-T4 and T2-T4 panels). This cannot be simply attributed to syllable frequency because even on the T2-T4 continua on which the syllable frequency of the T2 endpoint is much higher than that of the T4 endpoint (844 vs. 233 token frequency (Tseng, 2019)), the listeners still classified the items on these continua more often as T4. Moreover, on the T3-T4 continua, there was an apparent bias against the T3 endpoints (a reversed pattern between solid and dotted lines from the other tone pairs in Fig. 2), regardless of lexicality, suggesting a strong markedness effect. This markedness effect was also observed on the T2-T3 continua: when Mandarin listeners were presented with clear T3 tokens, they were still reluctant to identify them as T3. These two tones caused general confusion as indicated by the linear function on the tonal identification of the items on the T2-T3 continua, presumably due to the morphological alternation of the two tones (e.g., Huang, 2001; Hume & Johnson, 2003). Taken

together, the results of this study contribute to our understanding of tonal categorization in relevance to tonal markedness and tone frequency.

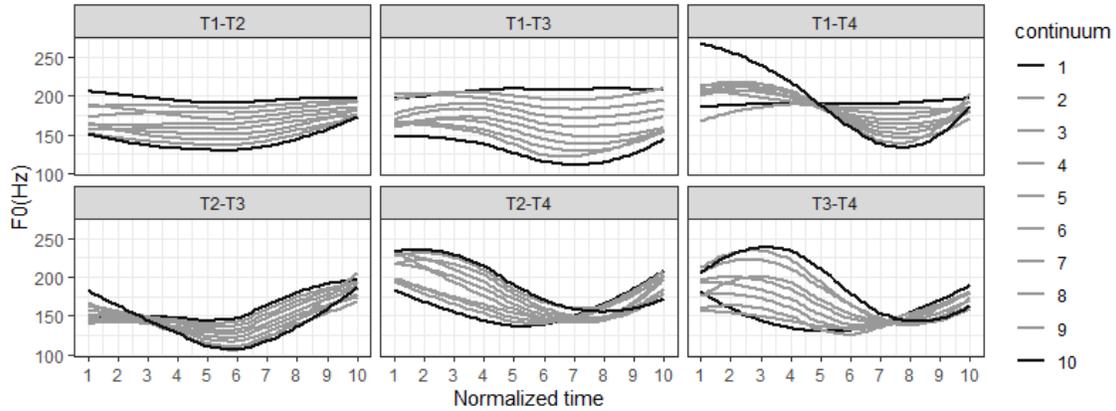


Figure 1. f0 trajectories of tokens synthesized using Tandem-STRAIGHT

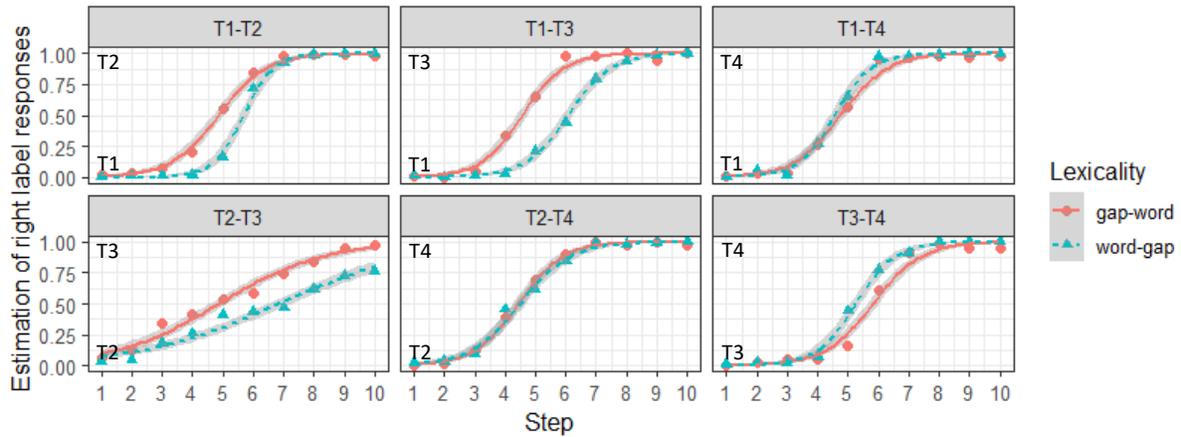


Figure 2. Estimated right label tonal responses on gap-word (solid lines) word-gap (dotted lines) continua on the six tone pairs

Selected references

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