Mandarin Chinese tone sandhi modulates sentence completions (to a limited extent)

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Evidence for the use of phonological information in real-time lexical prediction remains limited: although some studies reported prediction effects based on phonological cues with slow speech rates [1-2]; such evidence has remained elusive with more naturalistic speech rates [3]. In addition, a recent study has found minimal effects of phonological cues on listeners' cloze responses [4], leaving open the question of whether such cues influence comprehenders' expectations about upcoming language input on the lexical level. In this study, we looked at two tone sandhi patterns in Mandarin Chinese (the T3 sandhi and the *yi* sandhi) and used a forced-choice sentence completion task to investigate the effect of phonological cues on listeners' responses. Both of these tone sandhi rules were right-dominant, meaning the tone of the first syllable in the sandhi domain was determined by the syllable that follows. As such, the first syllable's tone is informative about the upcoming syllable's tone. Participants listened to sentence frames ending with a critical syllable realised in either its base tone or sandhi tone, while having to choose between two written continuations of the sentence that differed in their compatibility with the critical syllable's tone. **Results show that tone sandhi influenced sentence completion responses**, but the small size of the effects suggest that listeners cannot use tone sandhi to rule out phonologically incompatible continuations.

Methods. Participants (n=50) listened to non-constraining sentence frames ("Wang thoughtfully prepared …") and were asked to select their preferred continuation between two noun phrases (NPs) on the screen. The NPs always shared the same initial monosyllabic word or morpheme, but it was realised in different tonal forms due to tone sandhi applying in one of the NPs (e.g. *hao3 cha2* 'good tea' vs. *hao2 jiu3* 'good wine'). In the Experimental condition, the sentence frame was truncated after the first syllable of the target NP (the critical syllable) which was realised either in the base tone or the sandhi tone (e.g. "… *hao2* …"). Only one of the NPs (the target) was compatible with the tone of the critical syllable, while the other (the competitor) was not. As such, the critical syllable's tone was indicative of the identity of the target. In the Control condition, in contrast, the spoken sentence was truncated right before the critical syllable, leaving no tonal information to help identify the target NP. The numeral *yi* ('one') was used to test the *yi* sandhi, where *yi* is realised in tone-4 (T4) before all syllables except for T4 syllables, in which case *yi* is realised in T2. The numeral *liang* ('two'), as well as T3 adjectives and T3 morphemes, were used to test the T3 sandhi, where the first T3 syllable in a consecutive T3T3 string is realised in T2.

If listeners are sensitive to the tone of the critical syllable, they should be able to correctly identify the target in the Experimental condition, but not in the Control condition.

Results. Mixed-effects linear models revealed a higher rate of target responses in the Experimental condition than the Control condition across all critical syllable types (Figure 2). However, a non-negligible error rate (>25%) was found in all Experimental conditions, indicating that listeners selected the competitor a significant proportion of the time even though it was phonologically incompatible with what they heard (Figure 3).

Conclusions. Our findings suggest that listeners are sensitive to tone sandhi as an informative cue in selecting sentence continuations, but this sensitivity is rather limited. Although listeners somewhat adjusted their expectations about upcoming lexical input according to tone sandhi cues, they were still happy to accept continuations that were phonologically incompatible with the given tonal cue.

These results can provide insights into the role of phonological cues in real-time lexical prediction: although tone sandhi seems to influence comprehenders' lexical expectations, they cannot completely inhibit cue-incompatible words after hearing a tone sandhi cue. This can possibly explain why lexical predictions based on tone sandhi cues can be difficult to observe.

References

[1] Ito, A., & Hirose, Y. (2024). Quarterly Journal of Experimental Psychology.
[2] Shun L, Chen X, Wang S. https://doi.org/10.31219/osf.8kdc4
[3] Huo, Y., & Chow, W.Y. (2024). Poster presented at LingO 2024: Oxford Postgraduate Conference in Linguistics, Jesus College, Oxford, UK.

Table 1 Types of critical syllables used in the experiment, and their relative tone sandhi patterns. NB: the true base tone of yi is T1 – how it is pronounced in isolation. Since in the current study, yi never appeared in isolation, we annotated yi4 as the 'base' form as it is compatible with more tones than yi2.

Critical syllable type	Tone sandhi	Base form	Base form example	Sandhi form	Sandhi form example
yi ('one')	Yi sandhi	*yi4*	*yi4 zhang1/tiao2/ba3*	*yi2*	*yi2 ge4*
liang ('two')	T3 sandhi	*liang3*	*liang3 zhang1/tiao2/ge4*	*liang2*	*liang2 ba3*
T3 adjective (e.g. *xiao3*)	T3 sandhi	*xiao3*	*xiao3 mao1/she2/lu4*	*xiao2*	*xiao2 gou3*
T3 morpheme (e.g. *jing3*)	T3 sandhi	*jing3*	*jing3che1/jing3ju2/jing3wei4*	*jing2*	*jing2quan3*

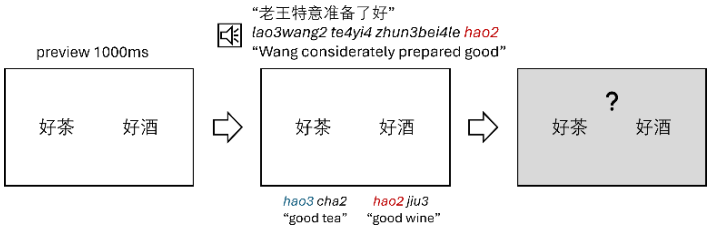

Figure 1. Experimental procedure (Experimental condition). The target and the competitor shared the first syllable, but differed in tone due to tone sandhi applying to one of them. In the Experimental condition, only the target was compatible with the critical syllable's tone. In the Control condition, the critical syllable was truncated and both NPs were equally compatible/plausible.

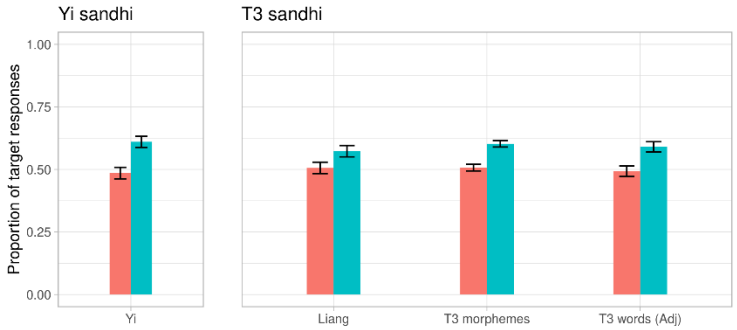

Figure 2. Proportion of target responses in the four types of critical syllables.

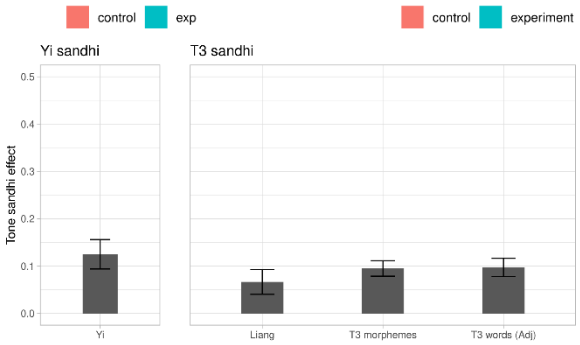

Figure 3. Tone sandhi effects for the four types of critical syllables (i.e. proportion of target responses in the Experimental condition – Control condition).