Listeners do not use Mandarin tone sandhi to make lexical predictions: evidence from printed-word visual world paradigm

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Introduction

- Recent studies have proposed that informative phonological cues, such as Japanese pitch accent and Mandarin Chinese tone sandhi, may be used to predict upcoming lexical items at slow speech rates [1, 2].
- In contrast, a study by Huo & Chow [3] suggested that Mandarin Chinese listeners may not use tone sandhi in a numeral to predict upcoming words (classifier and noun) at a naturalistic speech rate.
- However, in their experiment, even though the tone of the numeral was predictive of that of the classifier (and thereby the noun), the classifiers were never depicted in the visual display.
- To address this, we utilized a printed-word version of the visual world paradigm to present complete noun phrases, including the numeral, classifier, and noun to the participants in place of line drawings.

Methods

- Participants (n=35) viewed pairs of written noun phrases on the screen as they listened to non-constraining sentence fragments that ended with one of the written NPs (a numeral, a classifier, and a head noun).
- In the Different Tones (Experimental) condition, the classifier in one of the NPs triggered tone change (tone sandhi) in the numeral. Thus, the tone of the numeral provided an early cue of the target's identity.
- In the Same Tones (Control) condition, neither of the classifiers triggered tone sandhi, so the numeral's tone was uninformative about the target's identity.

Tone sandhi	Numeral	Base Form	Base Example	Sandhi Form	Sandhi Example
***Yi* sandhi**	*yi* ('one')	*yi4*	*yi4 zhang1/tiao2/ba3*	*yi2*	*yi2 ge4*
T3 sandhi	*liang* ('two')	*liang3*	*liang3 zhang1/tiao2/ge4*	*liang2*	*liang2 ba3*

Table 1. Illustration of tone sandhi patterns tested in the current study.

"李 叔叔 看到 两 张 床。"
"Li3 shu1shu kan4-dao4 liang3 zhang1 chuang2."
Li uncle see-PAST two CL_{zhang} bed
"Uncle Li saw two beds."

Experiment condition (Different Tones)

两张床 两把凳子

liang3 zhang1 chuang2 liang2 ba3 deng4zi
two CL_{zhang} bed two CL_{ba} stool

Control condition (Same Tones)

两张床 两扇门

liang3 zhang1 chuang2 liang3 shan4 men2
two CL_{zhang} bed two CL_{shan} door

Figure 1. Illustration of stimuli.

Results

- Estimated differences between conditions (Experiment - Control) in terms of onset of fixations on the target phrase were [-160, 0]ms for trials involving the T3 sandhi and [-120, 0]ms for trials involving the *yi* sandhi.
- This shows a **non-significant trend** of earlier fixations on the target in the Experimental than the Control condition.
- Applying Bayesian principles to the distribution of divergence points using principled priors revealed **anecdotal to no support for prediction effects** (*yi*: BF10=0.91; T3: BF10=2.42).

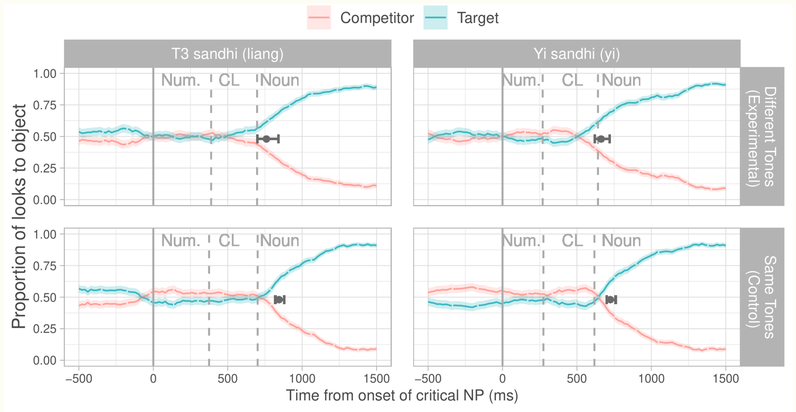

Figure 2. Proportion of looks to the objects. Solid points and error bars represent mean divergence point (onset of looks to target) and 95% confidence interval.

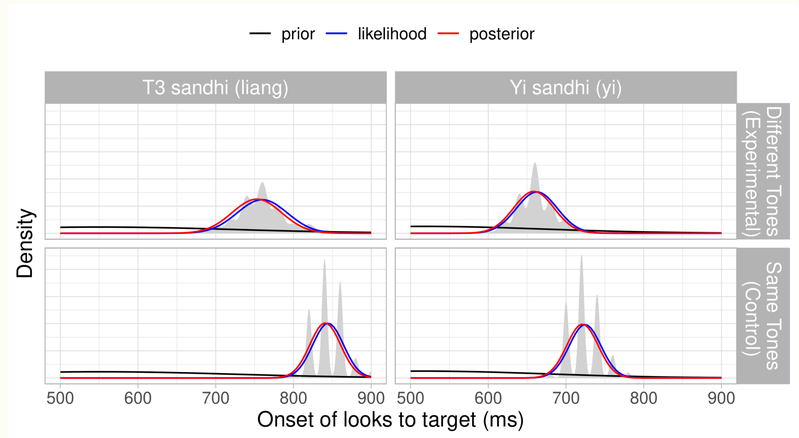

Figure 3. Applying Bayesian principles to the distribution of divergence points (onset of fixations on the target), with principled priors.
Prior: Assuming the onset of fixations to the target was no earlier than the onset of the numeral, and no later than the offset of the classifier.
Likelihood: Distribution of divergence points obtained from the divergence point analysis [4].
Posterior: Posterior distributions calculated using Bayes' theorem.

Discussion

- Our results show that at a naturalistic speech rate, Mandarin Chinese tone sandhi cues do not significantly inform listeners' lexical predictions.
- This may be because while tone sandhi cues can inform the listener about the phonological form of an upcoming lexical item (e.g. *liang2* predicts an upcoming T3 syllable), they do not pose any semantic restrictions on the possible set of upcoming words.
- Consequently, tone sandhi cues may be less effective in lexical predictions, which could explain why they are not used as readily as cues that are more semantic in nature.
- Our results suggest that even with a visual display that greatly limited the set of possible upcoming words, it remains challenging to observe lexical predictions based on tone sandhi cues with more naturalistic speech, calling into question the role of phonological cues as an input to lexical predictions.

References

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