Gap between comprehenders' linguistic knowledge and their ability to make predictions: evidence from Mandarin Chinese tone sandhi

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Overview

- Humans use a wide array of information to generate predicitons about upcoming language input [1, 2].
- In this study, we investigate whether listeners of Mandarin Chinese use tone sandhi information to make predictions of upcoming classifiers and nouns.
- We conducted two visual world eye-tracking experiments and an acceptability experiment.
- Results suggest that **although listeners have robust linguistic knowledge about tone sandhi, they do not seem to effectively use that to generate predictions.**

Experiment 1A: Eye-tracking

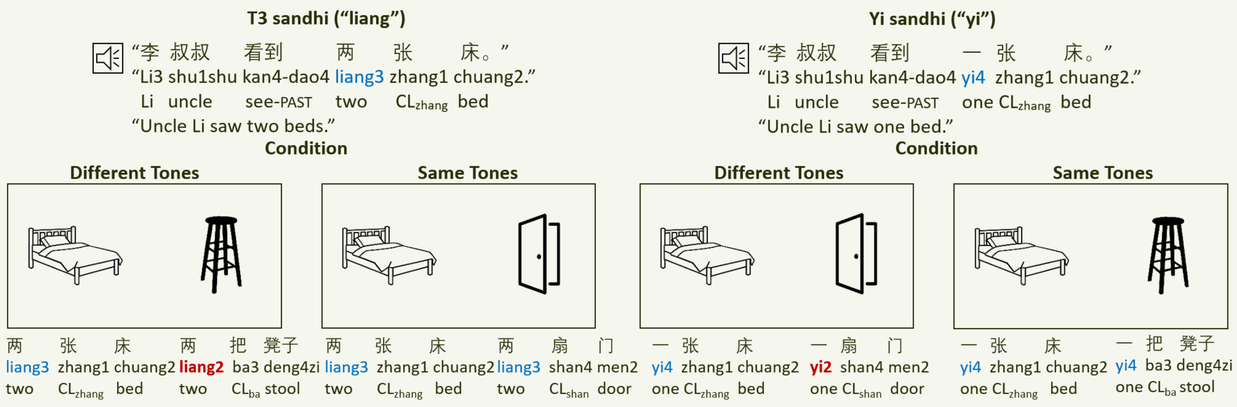

Figure 1. Sample stimuli, Exps 1A and 2. The numeral's tone was informative of the target's identity in the Different Tones condition, but uninformative in the Same Tones condition.

• Participants (n=43) saw pairs of objects while listening to unconstraining sentences that identified the target object using a numeral-classifier-noun phrase (critical NP) (Fig 1).

• The tone of the numeral was informative about the target in the Different Tones condition but uninformative in the Same Tones condition.

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

Table 1. Illustration of tone sandhi patterns tested in this study. The true base form of *yi* is *yi1* – how it's pronounced in isolation. However, since *yi* in this study never appeared in isolation, we thus annotate *yi4* as the 'base form' here for simplicity, as it is compatible with more tones than *yi2*.

• Divergence point analysis [3] revealed that listeners looked towards the target more quickly in the Different Tones condition than the Same Tones condition in *liang* (T3 sandhi) trials, but not in *yi* (*yi* sandhi) trials.

• This suggests that listeners used the T3 sandhi, but not the *yi* sandhi, to make predictions.

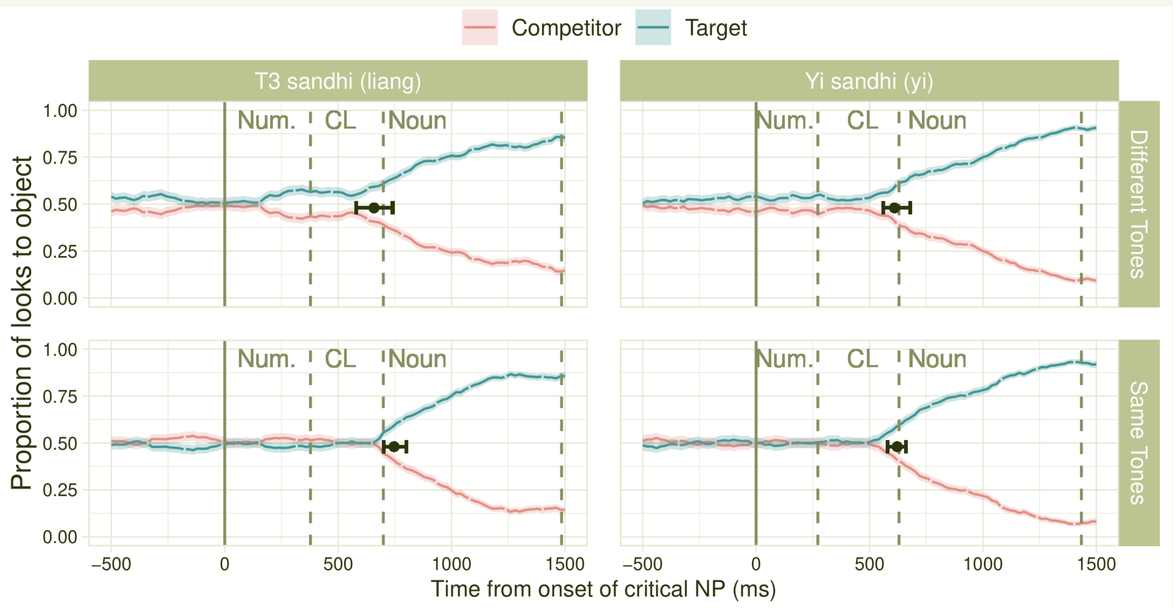

Figure 2. Proportion of looks to objects, Exp 1A. Solid points and horizontal error bars indicate the mean onsets of more looks to the target object as well as the 95% CIs.

Experiment 1B: Acceptability

- Participants (n=40) viewed written Mandarin Chinese numeral-classifier phrases and rated the acceptability of an audio recording on a 7-point scale.
- The recording either *complied* with or *violated* the relevant tone sandhi pattern (i.e. either phonologically grammatical or ungrammatical).
- 2 x 2 x 2 design: tone sandhi (*yi* vs. T3), phonological context (whether the classifier should induce a tone change, sandhi-inducing vs. non-inducing), and grammaticality (grammatical vs. ungrammatical).
- Acceptability ratings of the recordings revealed that listeners were **sensitive to violations of both the T3 sandhi and the *yi* sandhi**, suggesting **robust knowledge of both tone sandhi patterns**.

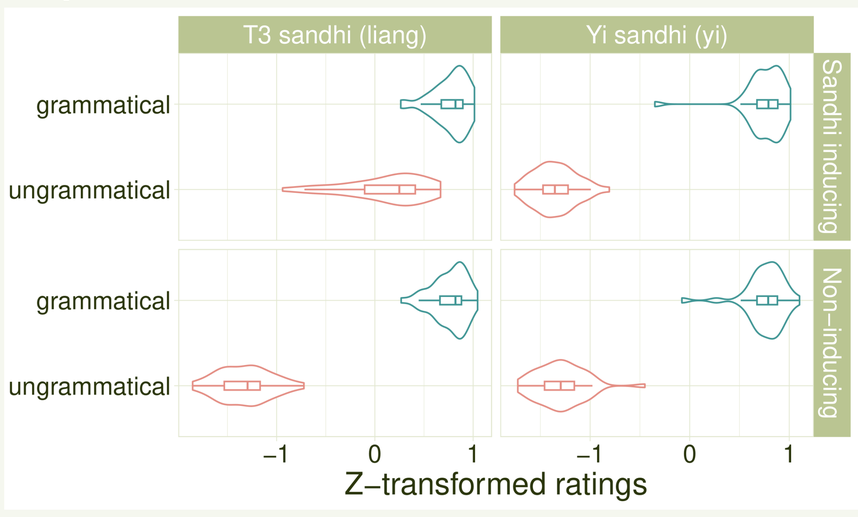

Figure 3. Z-transformed by-participant acceptability scores, Exp 1B. Results suggest sensitivity to violations of both tone sandhi patterns, although a reduced sensitivity was observed to T3 sandhi violations in the sandhi inducing context (T3-T3 pairs).

Experiment 2

- Direct replication of Exps 1A + 1B in a single group (n=43).
- Acceptability results replicated Exp 1B. However,
- Eye-tracking results revealed **no significant effects of prediction for both the T3 sandhi and the *yi* sandhi**.
- Applying Bayesian principles to the divergence point data with the data from Exp 1A as priors revealed Bayes factors that support the H0 that **listeners could not use either tone sandhi to predict** (BF10 = 0.72 for *yi*; 0.14 for *liang*).
- No significant correlation between listeners' sensitivity to tone sandhi violations and their ability to use tone sandhi to predict.

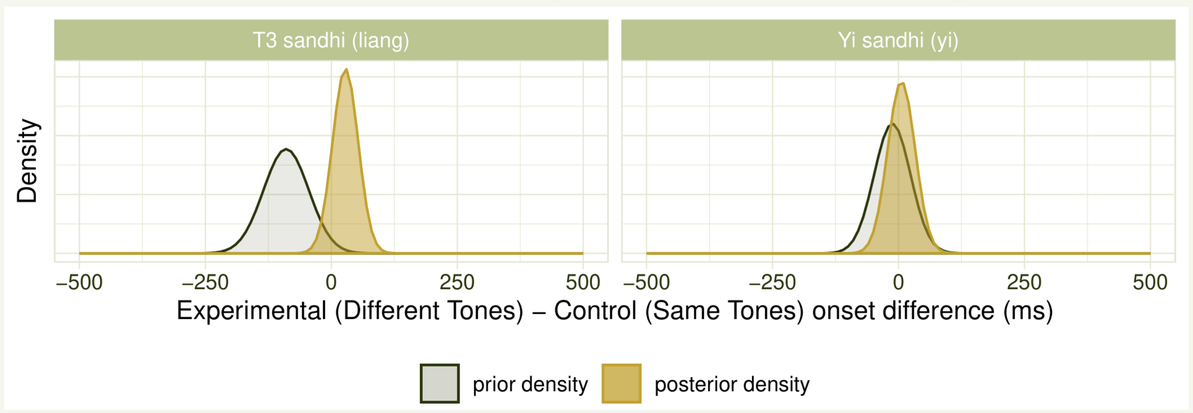

Figure 4. Applying Bayesian principles to divergence point data, using the results from Exp 1A as the prior and the results from Exp 2 as the likelihood. A posterior distribution of onset difference that covers 0 indicates support for the null hypothesis that there is no difference between conditions in the onset of looks to the target object.

Discussions

- Native speakers of Mandarin Chinese are highly sensitive to violations of the T3 sandhi and the *yi* sandhi, suggesting good linguistic knowledge.
- However, **they were unable to use either sandhi pattern in a numeral to predict an upcoming classifier and noun**.
- Our results suggest **a contrast between comprehenders' linguistic knowledge and their ability to use such knowledge to generate predictions in real time**.
- This gap between offline knowledge and online prediction may be due to the time available for prediction, or a delay in phonological information's availability in prediction.

References

[1] Van Petten, C., & Luka, B. J. (2012). Prediction during language comprehension: Benefits, costs, and ERP components. *International Journal of Psychophysiology*, 83(2), 176-190.

[2] Kamide, Y. (2008). Anticipatory processes in sentence processing. *Language and Linguistics Compass*, 2(4), 647-670.

[3] Stone, K., Lago, S., & Schad, D. J. (2021). Divergence point analyses of visual world data: Applications to bilingual research. *Bilingualism: Language and Cognition*, 24(5), 833-841.