# Integration of Mandarin third tone sandhi in auditory sentence disambiguation

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## Background

### Mandarin Third Tone Sandhi (T3S)

- Low + Low -> Rising + Low

### T3S and the Prosodic Structure (*Shih, 1986, Kuang and Wang, 2006*)

- Mandatory within foot, optional across feet.
- More likely at smaller than larger prosodic breaks.
- $F_0$ contours are sharper at smaller than larger prosodic breaks.

### Research Question

- Will listeners integrate T3S to assist syntactic parsing and sentence disambiguation, by attending to a) whether T3S applies and b) the pitch shape of T3S if it applies?

## Experiment

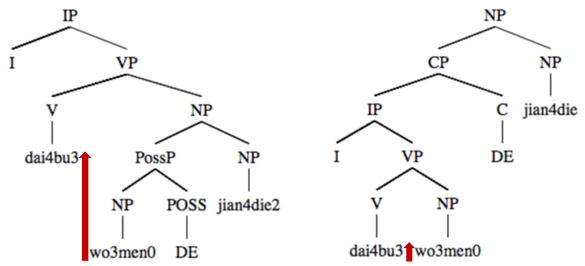
### Stimuli

- 27 critical sentences with two consecutive T3 syllables and 27 filler sentences without them, both being ambiguous.
- For the former, interpretation depends on whether the two T3 syllables were separated by a major or minor syntactic juncture.

(1) 逮捕 我们 的 间谍
dai4bu3 wo3men de jian4die2
arrest 1PPL POSS/RC spy

(1a) Major-juncture:
*'Arrest our spy.'*

(1b) Minor-juncture:
*'The spy that arrest us.'*




### Conditions

- Each stimulus manipulated into 3 pitch (low, shallow-rising, sharp-rising) by 2 phrasal-timing (shortened, normal) conditions.
- Three lists constructed, across which the pitch conditions of stimuli were counterbalanced.

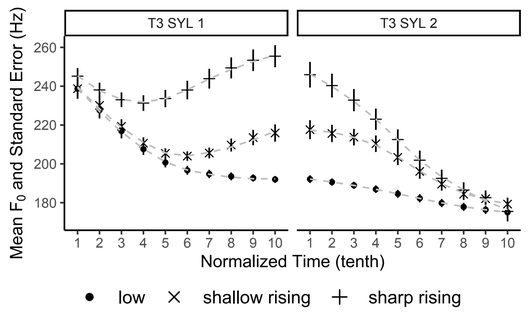



*Fig. 2. $F_0$ contours of the two T3 syllables under three tonal patterns*

### Participant and Procedure

- 60 native Mandarin speakers did an online auditory sentence comprehension task, choosing from two written paraphrases the one consistent with what they heard.
- Listeners assigned randomly to one of the lists; each listener heard each stimulus only in one pitch condition.

## Results

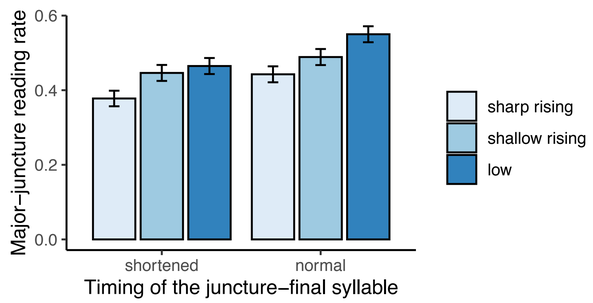



*Fig. 3. The mean and standard error of major juncture reading rates*

*Table 1. GLM Response ~ Timing/Tone + (1|Group/Subj) + (1|Sentence)**

| Fixed Effects | | β | SE | z | Pr(>\|z\|) |
|---|---|---|---|---|---|
| (Intercept) | | -0.32 | 0.2 | -1.6 | 0.11 |
| Timing(Normal) | | 0.32 | 0.08 | 4.06 | <0.001*** |
| Timing | Tone(SharpR-ShallowR) | 0.23 | 0.13 | 1.68 | 0.09. |
| (Normal) | Tone(ShallowR-Low) | 0.3 | 0.13 | 2.25 | 0.02* |
| Timing | Tone(SharpR-ShallowR) | 0.35 | 0.14 | 2.54 | 0.01** |
| (Shortened) | Tone(ShallowR-Low) | 0.09 | 0.13 | 0.69 | 0.49 |

**Coding: Response*: Minor-reading as the reference; *Timing*: Shortened as the reference; *Tone*: repeated-coded, SharpRising-ShallowRising-Low.

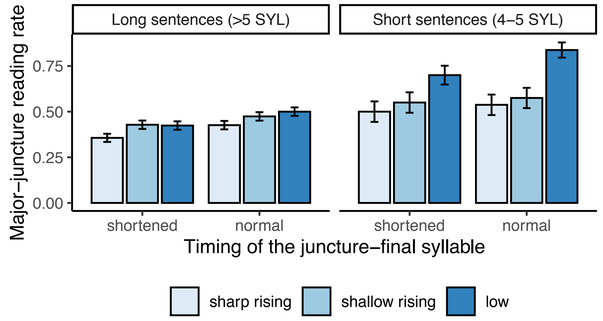



*Fig. 4. The mean and standard error of major juncture reading rates of long and short sentences*

(2) 我 写 不 好
wo3 xie3 bu4 hao3
1PSG "write" NEG "good/well"

(2a) Major: (wo3)(xie3 bu4 hao3) *'I cannot write (it) well.'*

(2b) Minor: (wo3 xie3)(bu4 hao3) *'It is not good that I write (it).'*

*obligatory T3 sandhi within a foot*

## Discussion

- Evaluated the role of a prosodically constrained phonological variable, i.e., Mandarin T3S, in auditory sentence parsing.
- Showed that listeners integrate both phonological (apply or not) and phonetic (pitch contours) aspects of T3S.
- Found that listeners' strategies were consistent with the context-dependent efficiency of different cues (e.g., sentence length).
- Indicated listeners' sophisticated knowledge of variability, and ability to make efficient use of them when appropriate.

## Acknowledgement

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### Selected Reference

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