Perception of Stress in Disyllabic Words in Changsha Xiang: The Effects of Syllable Duration and F0 Contour

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Introduction

In Chinese, lexical stress has been approached from the perspective of neutral/neutralised tones [1, 2]. **Changsha tones are shortened and flattened in the σ2 of trochees** [3, 4] (Figure 1).

34, 13 → 33 / $T_{[+stress]}$ ___
42, 24 → 44 / $T_{[+stress]}$ ___
21 → 21 / $T_{[+stress]}$ ___
45 → 55 / $T_{[+stress]}$ ___ (underline = shortened)

☞ Scan to hear the minimal pair:
[ˈɕiã34 tɕiɑu33] (‘banana’, trochaic)
[ɕiã34 ˈtɕiɑu34] (‘to intersect’, iambic)

How do tonal listeners use acoustic cues for stress perception? - Found in 2 lines of research:

Perceiving the Mandarin neutral tone

- Pitch is the most important perceptual cue [5].
  - Yet little is known about other tone languages.

Perceiving L2 lexical stress

- Chinese listeners outperformed non-tonal listeners in employing F0 cues [6, 7].
- Can we attribute this to just tonal background?
  - Perhaps not. Changsha listeners did better than Mandarin & Cantonese listeners with F0 [7].
  - Understanding of how metrical stress is perceived in the tonal L1 is a missing prerequisite for arguments of prosodic transfer.

Functional Load Hypothesis (FLH)

An acoustic property heavily loaded with one linguistic function is less likely to be used for another [8].

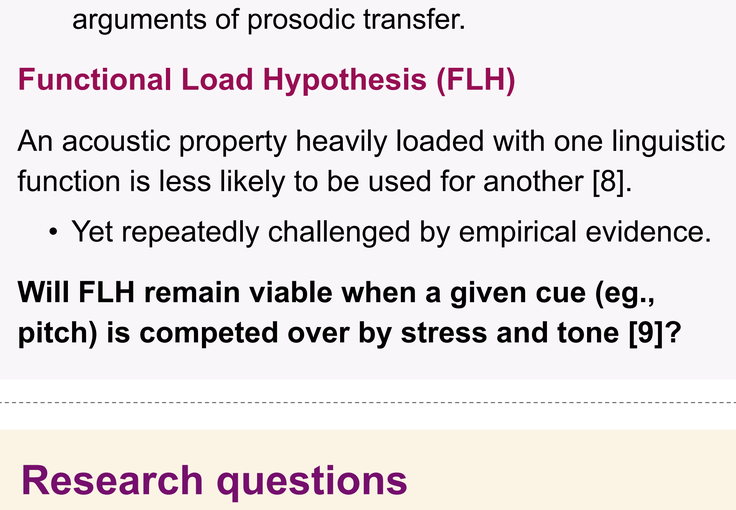
- Yet repeatedly challenged by empirical evidence.

Will FLH remain viable when a given cue (eg., pitch) is competed over by stress and tone [9]?

Research questions

1. *Do Changsha listeners use **syllable duration** and **F0 contour** in stress perception? If yes, which is assigned greater **perceptual significance**?*
2. *How do **lexical status** and **tone category** constrain the efficacy of syllable duration and F0 contour in cueing stress in Changsha Xiang?*

Figure 1. Semitone contours of stressed and unstressed σ2.



Notes:
1. The tone contours in Figure 1 are based on the materials recorded for the perception experiment.
2. Tone 3, usually notated as 42, is likely to have transformed into a high-level tone [4].

Methods

Stimuli

- **Real disyllabic words: 12 pairs**;
  - Embedded in 2 carrier sentences (naturalistic or metalinguistic contexts)
- **Pseudowords: 18 pairs.**
  - Phonotactically illegal ([raka], [roko], [riki]) to reduce the possible lexicality effect.
  - Primed by real word tonal references.
  - Embedded in 2 carrier sentences as a verbal (trochaic) or nominal (iambic) element.

Manipulation

All tokens normalised to 600 ms and 66 dB.

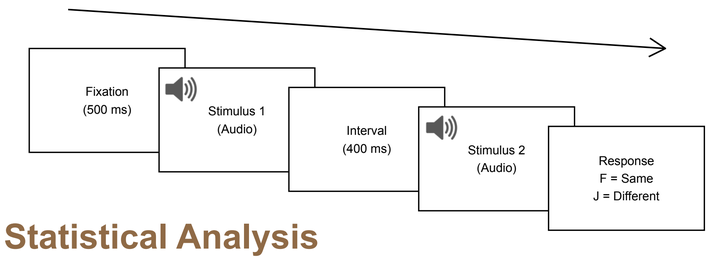
Three acoustic conditions:

- **Both cues**: no further manipulation.
- **F0 only**: all syllables reset to 300 ms; original F0 contours retained.
- **Duration only**: iambs were not manipulated; trochees were created from resetting iambic tokens to 340 : 260 ms (trochees with iamb F0 contours).

Procedure

- **30 native speakers** of Changsha (Female: 15; age range: 18-28; mean self-reported fluency: 87.10%).
- **360 formal trials** (12 real word pairs + 18 pseudoword pairs) × 4 pairing orders × 3 acoustic conditions.

Figure 2. Flow chart of the AX discrimination task.



Statistical Analysis

Three-way repeated measures ANOVAs

- DVs: Accuracy Rate, Reaction Time, or Sensitivity d’
- IVs: Acoustic Condition, Lexical Status, and σ2 Tone.

Results

- *Both cues were used for stress perception.*
- *The effect of **F0 contour is more important** than the effect of syllable duration.*
- *The pitch cue was more helpful in dealing with*
  - ***Larger acoustic/perceptual dissimilarity** between stressed and unstressed alternants;*
  - ***Real words** (lexicality advantage disappeared when F0 is obscured).*

Table 1. Results of Three-way RM ANOVA (Sensitivity d’).

	Wilk’s Lambda	F	Hypothesis df	Error df	Sig.	Partial eta squared
Acoustic condition	0.061	199.420	2	26	0.000	0.939
Lexical status	0.215	98.580	1	27	0.000	0.785
σ2 tone	0.071	59.978	5	23	0.000	0.929
Acoustic condition × Lexical status	0.286	32.433	2	26	0.000	0.714
Acoustic condition × σ2 tone	0.102	15.826	10	18	0.000	0.898
Lexical status × σ2 tone	0.275	12.132	5	23	0.000	0.725
Acoustic condition × Lexical status × σ2 tone	0.221	6.336	10	18	0.000	0.779

Figure 3. Sensitivity d’ by Acoustic Condition and Lexical Status.

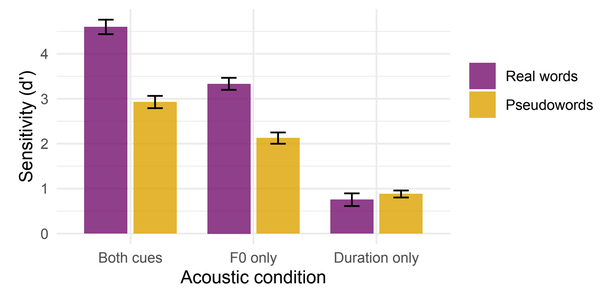


Figure 4. Sensitivity d’ by Acoustic Condition and σ2 Tone.

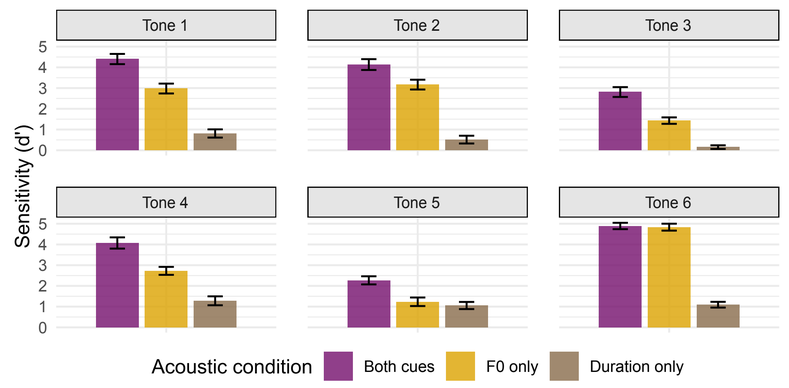
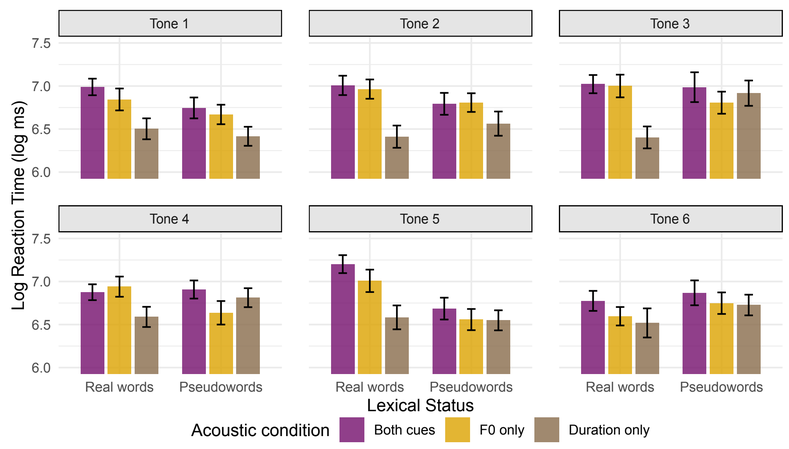


Figure 5. Log reaction time by Acoustic Condition, Lexical Status, and σ2 Tone.



Discussion

1. Functional Load Hypothesis? - Challenged

- *The pitch cue to stress remains paramount despite its role in contrasting lexical tones.*
- *Stress-tone interaction appears to exhibit typological diversification.*

2. Reference for L2 or bilingual research

- *Changsha listeners’ perceptual learning of non-native stress should reflect the perceptual mechanisms of native metrical structures.*

3. Future directions

- *Prosodic prominence at different levels*
- *Perceptual integration of acoustic cues*
- *Effect of morphosyntax and prosodic grouping*

Selected references

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