

# Acoustic cues for checked tone perception in Xiapu Min

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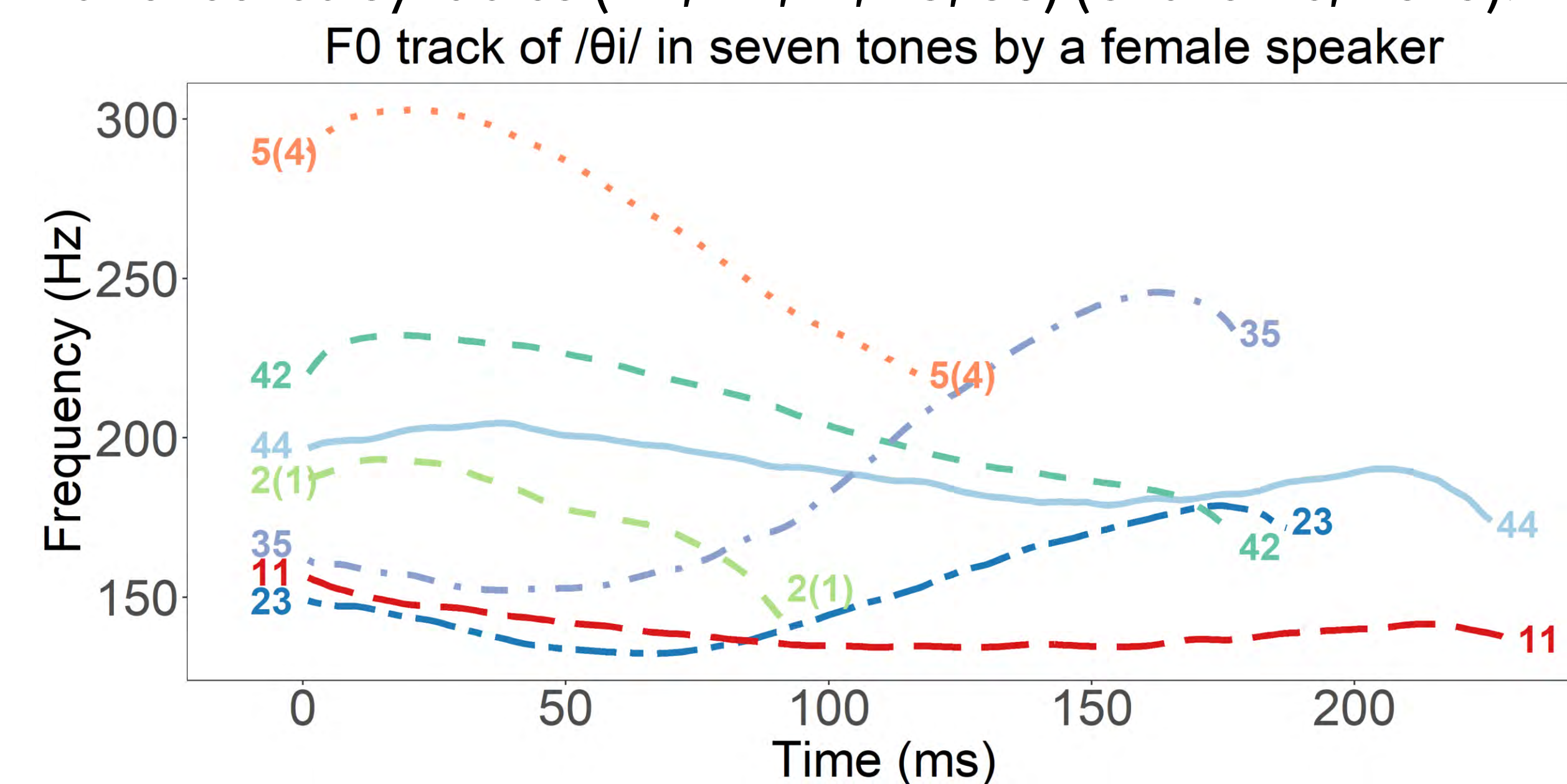
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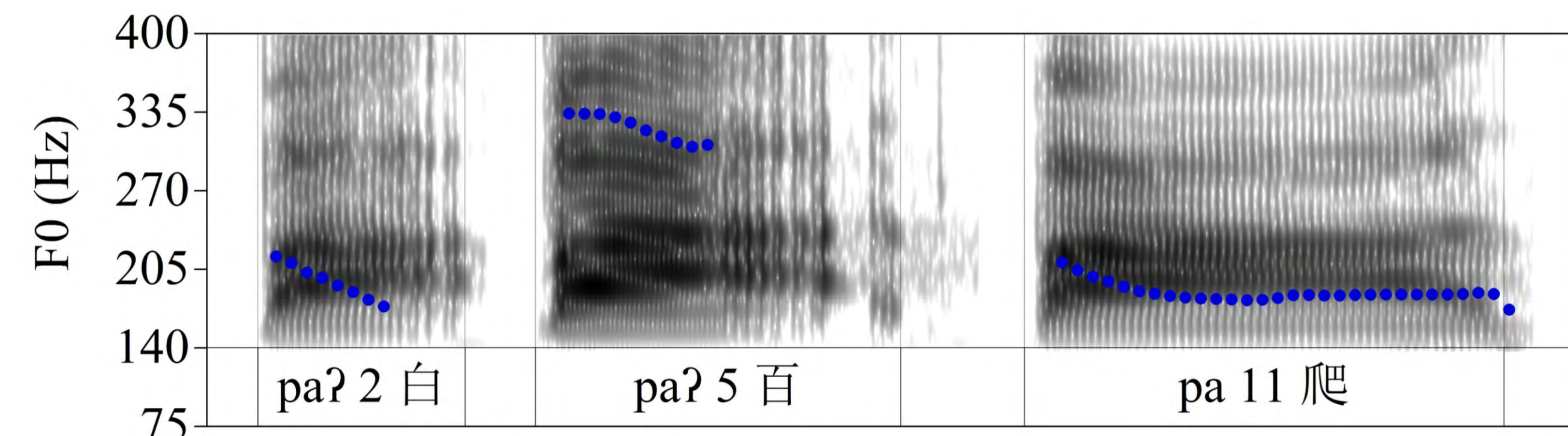
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## Introduction

- Xiapu Min have two checked tones associated with CV? checked syllables (53 and 21), and five unchecked tones associated with unchecked syllables (44, 42, 11, 23, 35) (Chai & Ye, 2019).



- Xiapu Min checked tones are characterized by distinct f0 height and contour, shorter duration, and creakier voice quality.



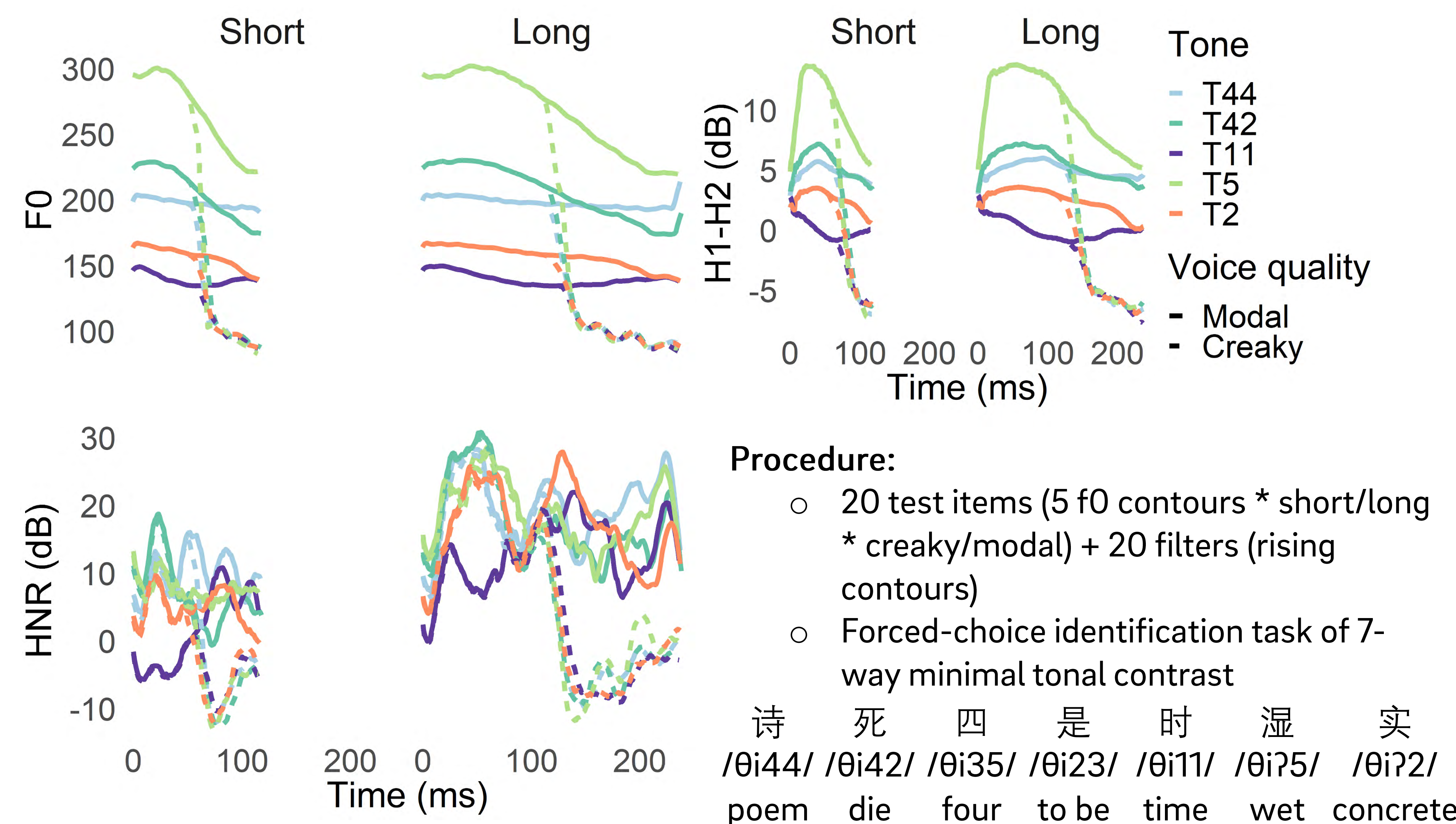
## Motivations & Questions

- F0, duration, and voice quality are essential cues in tone perception
  - F0: Onset pitch and pitch drop distinguishes the two falling tones in Hakka, Mandarin (Yeh & Lin, 2011), and Taiwanese Min (Yeh & Lin, 2012).
  - Duration: Shorter duration elicit more response of checked tones in Burmese (Gruber, 2011)
  - Creaky voice: Cantonese listeners use creaky voice to distinguish T4 from T6 when f0 is ambiguous (Yu & Lam, 2014)
- Do listeners of Xiapu Min make use of f0, duration, and voice quality when identifying a checked tone?
- If so, are listeners more sensitive to one cue than the other(s)?

## Method

- Subjects:** 16 native speakers of Xiapu Min
- Stimuli:** A naturally-produced /θi 44/ is manipulated
  - f0: Five tone contours :T44, 42, 11, 5, and 2
  - Duration:** Long vs. Short
  - Creaky:** Manipulate pitch track to be low and irregular

## Stimuli



## Results



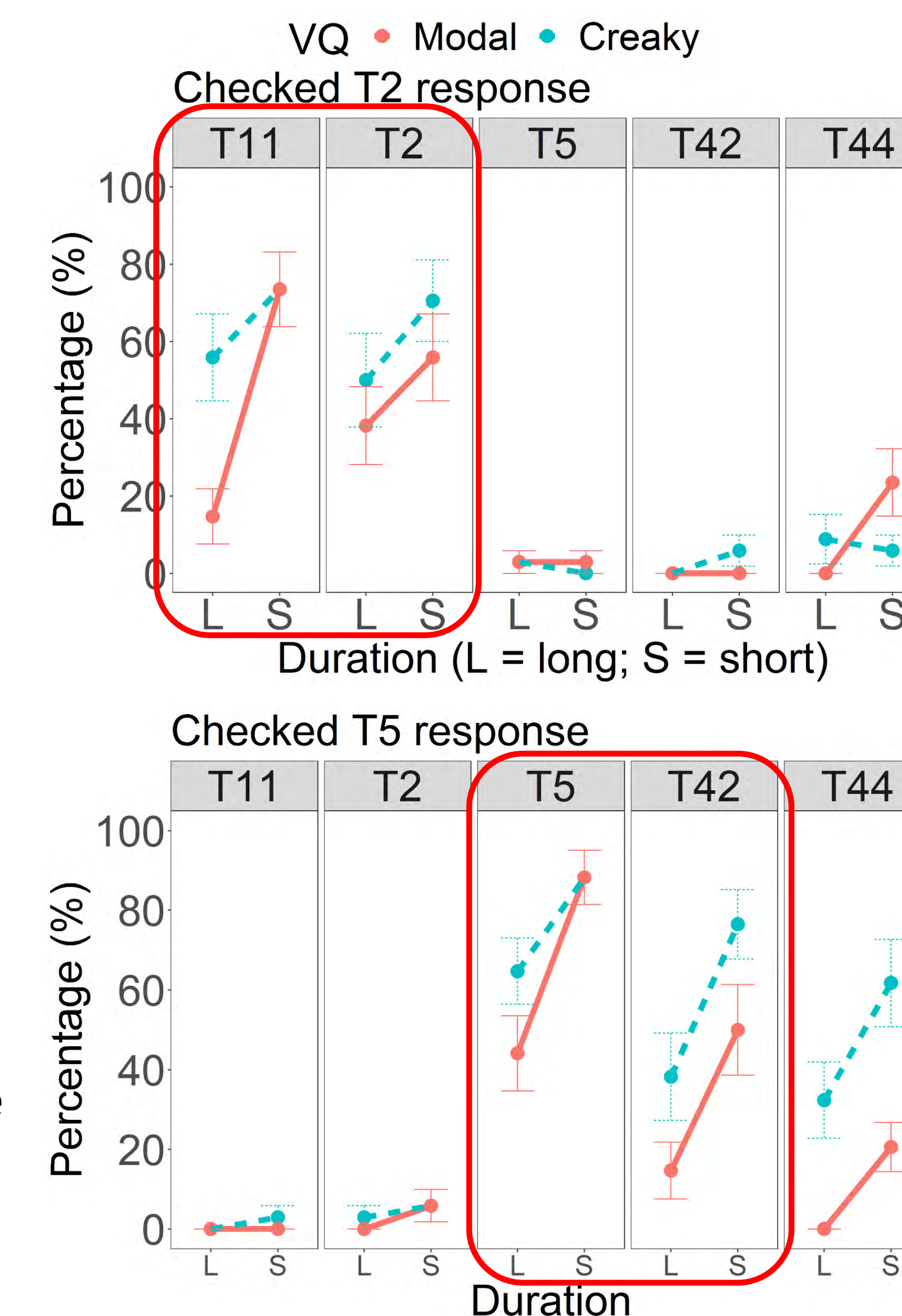
T2 response ~ Tone + VQ + Duration

	b	z	
T11,2 – T5, 42, 44	10.50	10.98	***
Short – Long	1.70	5.68	***
Creaky – Modal	0.76	2.78	**

T5 response ~ Tone + VQ + Duration

	b	z	
T5, 42, 44 – T11,2	13.21	8.57	***
T5, 42 – T44	2.10	6.56	***
T5 – T42	1.89	5.31	***
Short – Long	2.24	7.43	***
Creaky – Modal	1.69	5.92	***

## Discussion



### T2 response

Main effect F0 T11,2>T5,42,44  
Dur Short>Long  
VQ Creaky>Modal  
Tone\*Dur Add short to T11 > Add short to T2  
VQ\*Dur Add creaky to short < Add creaky to long  
Tone\*VQ\*D Add creaky to short for T11 < Add creaky to short for T2

### T5 response

Main effect F0 T5>T42>T44>T11,2  
Dur Short>Long  
VQ Creaky>Modal  
Tone\*VQ Add creaky to T5 < Add creaky to T42

## Conclusions

- Listeners of Xiapu Min make use of **f0**, **duration**, and **voice quality** when identifying checked tone.
  - Low f0, short duration, creak → Low-falling Checked T2 responses.
  - High-falling f0, short duration, creak → High-falling Checked T5 responses.
- Effect size: **F0 > Duration > VQ**
- There is a **ceiling effect** for **T11 short** and **T5 short** condition.
  - Adding creak does not elicit more checked responses.
  - Further evidence of creak having a smaller effect than f0 & duration.
- Future direction:
  - Test the **decomposability of f0** in checked tone perception.
  - Add pitch **height** and **contour** variations
  - Whether listeners are more sensitive to height or contour when identifying checked tones.

## References

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