

# Perception of checked tones in Xiapu Min – F0, duration, & voice quality

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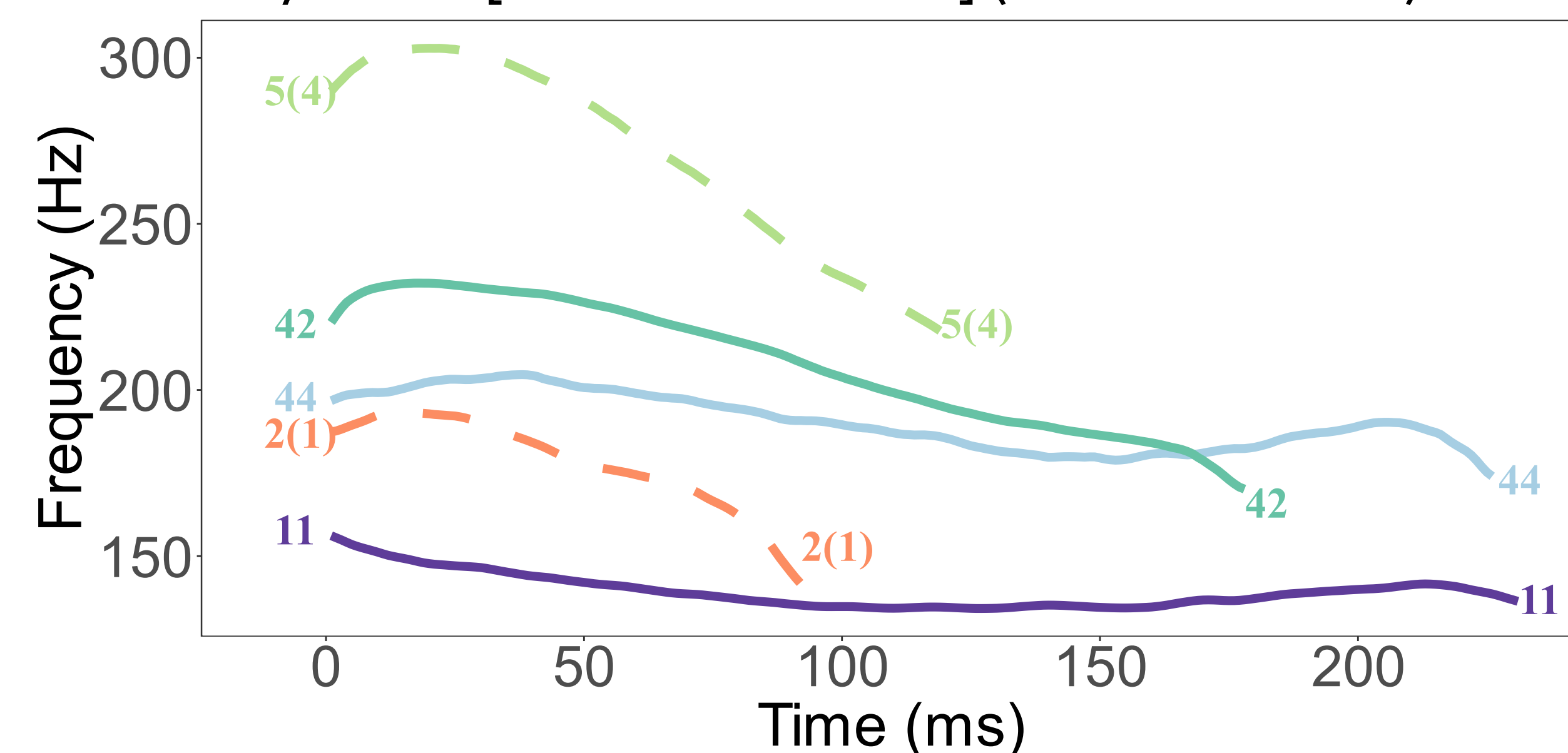
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ychaiucsd.github.io/website/

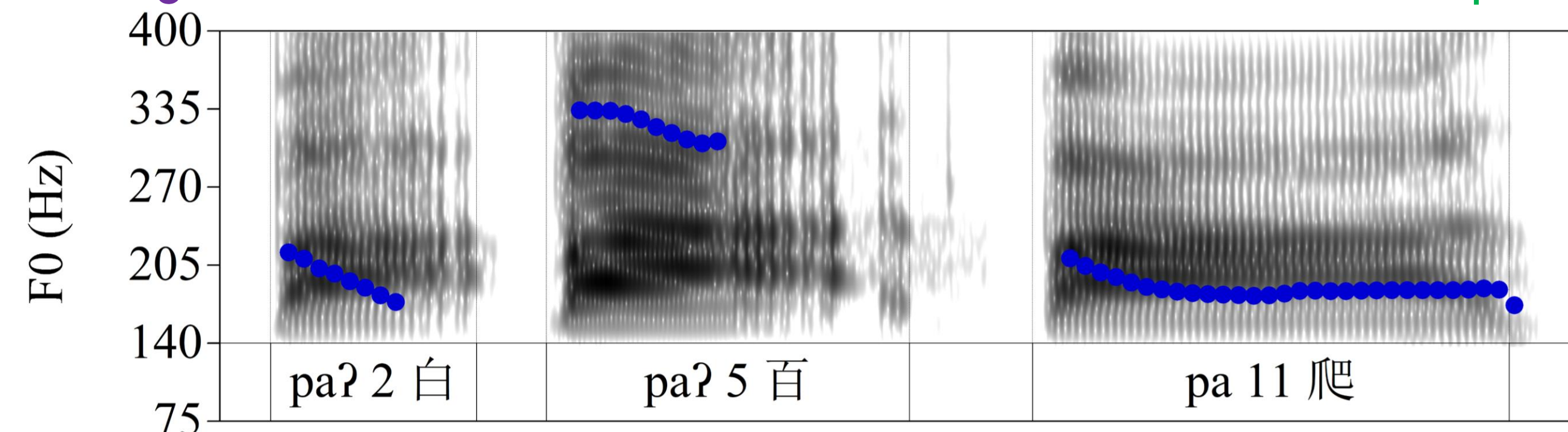
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## Introduction

- Xiapu Min has two checked tones associated with CV? syllables [5(4) and 2(1)], and five unchecked tones associated with CV/CVN syllables [44, 42, 11, 23, 35] (Chai & Ye, 2019).



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



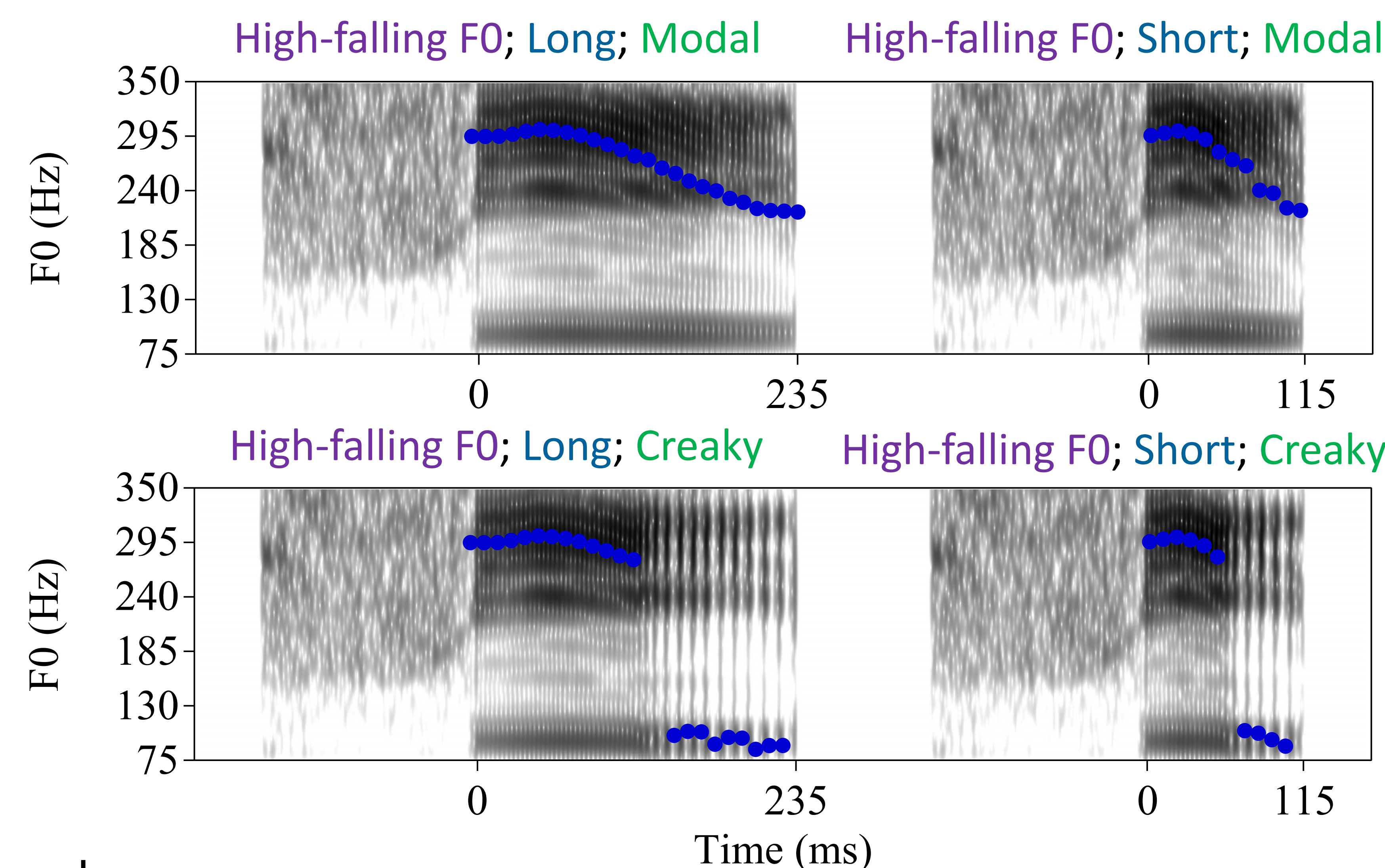
## Motivations & Questions

- 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, which cues matter most?

## Method

- Participants: 17 native speakers of Xiapu Min
- Stimuli: A naturally-produced /θi 44/ is manipulated into:
  - F0: F0 values of the modal part of naturally-produced:
    - T5 – high-falling
    - T2 – low-falling
    - T11 – low-level
    - T42 – mid-falling
    - T44 – mid-level
  - Duration: Short (vs. Long)
  - Creaky: Change latter half of pitch track to low and irregular

## Stimuli



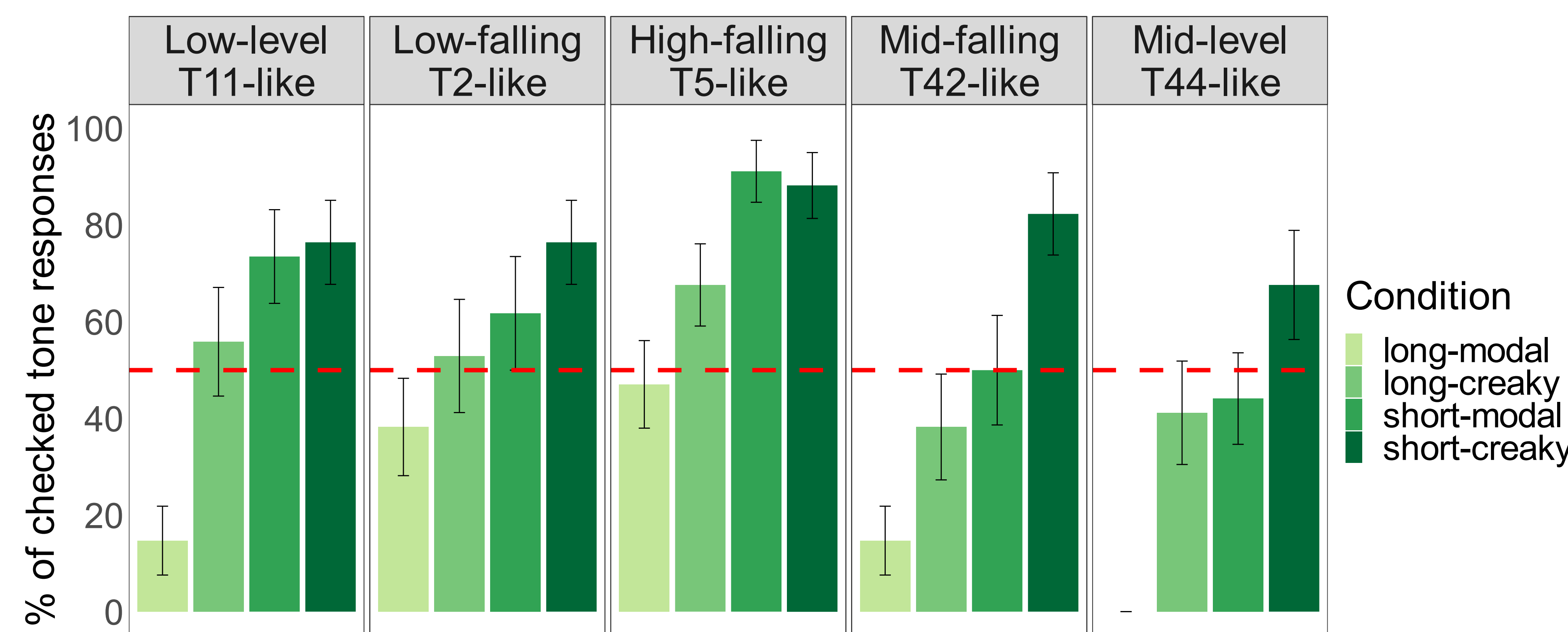
### Procedure:

- 20 test items (5 F0 contours \* short/long \* creaky/modal) + 20 filters (rising contours)
- Forced-choice identification task of 7-way minimal tonal contrast

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/θi44/ /θi42/ /θi35/ /θi23/ /θi11/ /θi75/ /θi72/  
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## Results

- Facet represents F0 conditions; color represents Duration and Voice quality conditions.

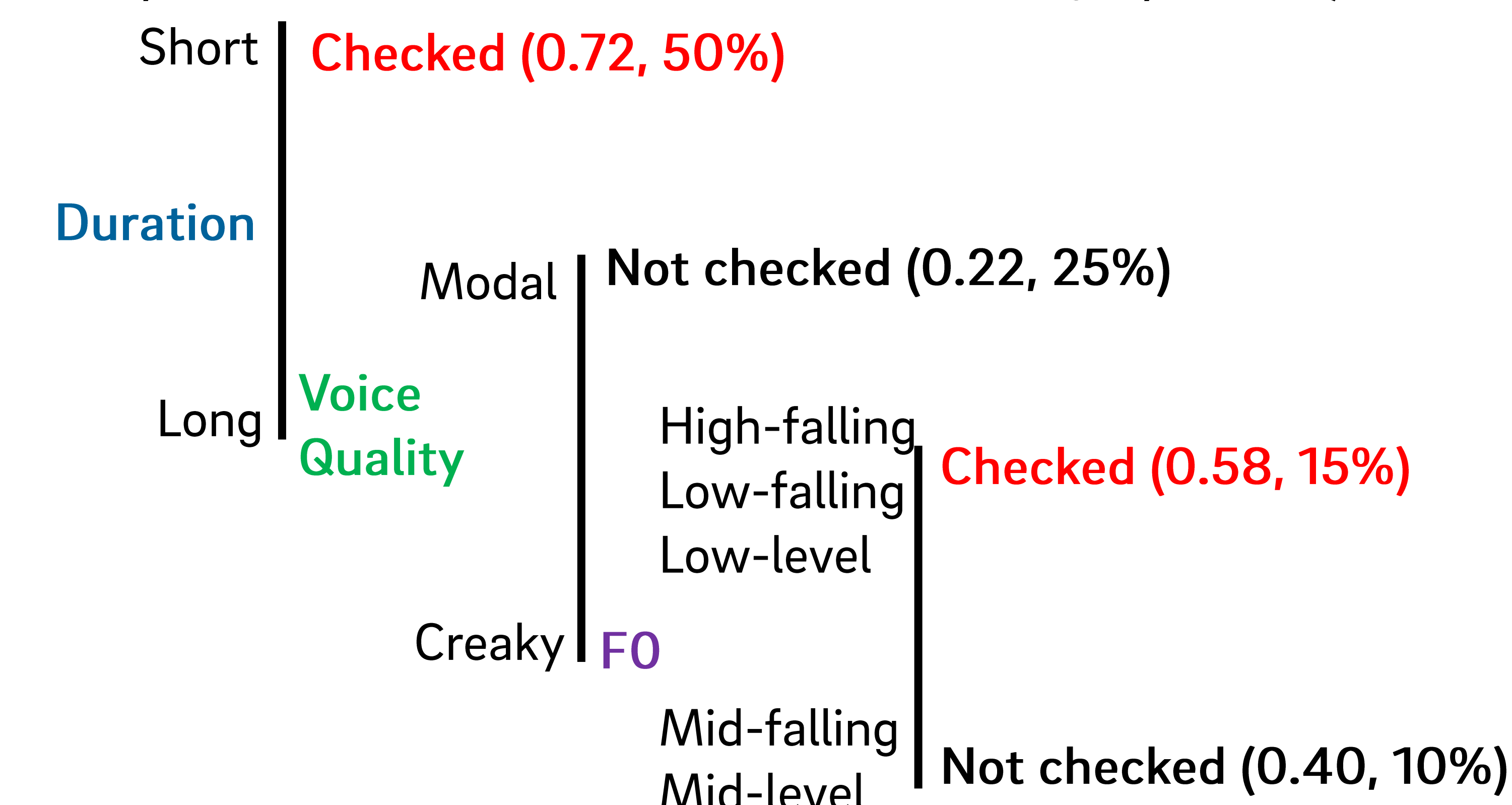


Condition	Low-level	Low-falling	High-falling	Mid-falling	Mid-level	Short	Long	Creaky	Modal
% of checked responses	0.55	0.57	0.73	0.46	0.38	0.71	0.37	0.65	0.44

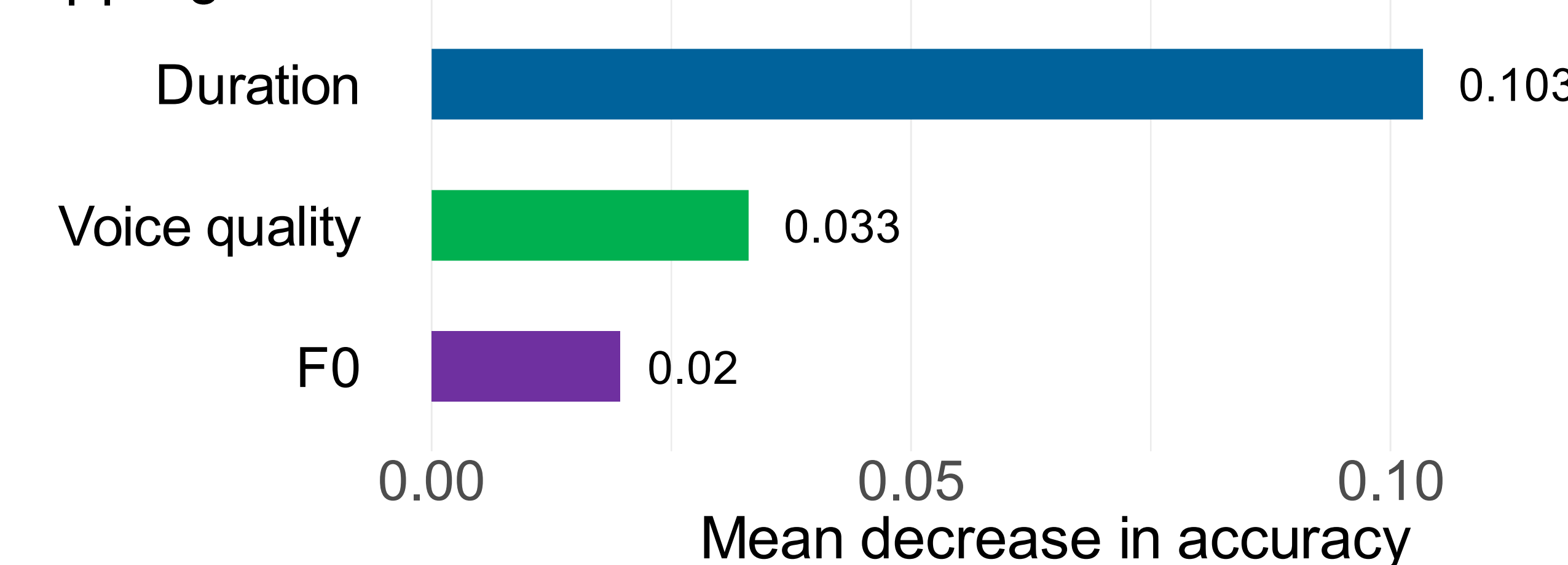
- On average, **high-falling F0**, **short**, and **creaky** conditions elicit the most "checked tone" responses.

## Discussion

Classification tree for what parameters lead to **checked tone responses** (probability of identified as checked tone, % of category in data)



Variable importance based on the decrease in classification accuracy if dropping the variable from the random forest model



## Conclusion

- In general, syllables with a **short** vowel elicit "checked tone" responses.
- If a vowel is **long**, it needs to be **creaky** and have the **F0 values of high-falling (T5-like), low-falling (T2-like), or low-level (T11-like)** to be identified as checked tone.
  - Classification results suggest that **duration** is the most important cue for checked tone identification, followed by **creaky voice** and **F0**.
  - Why **F0** of **high-falling, low-falling and low-level**? They are closest to the original F0 values of checked T2 and T5.
- Future study can test the decomposability of the parameters
  - F0** → Height and contour
  - Duration** → More levels of duration
  - VQ** → Add creak to the middle and the end of the vowel

## References

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