

# Lexical tone processing in human superior temporal gyrus

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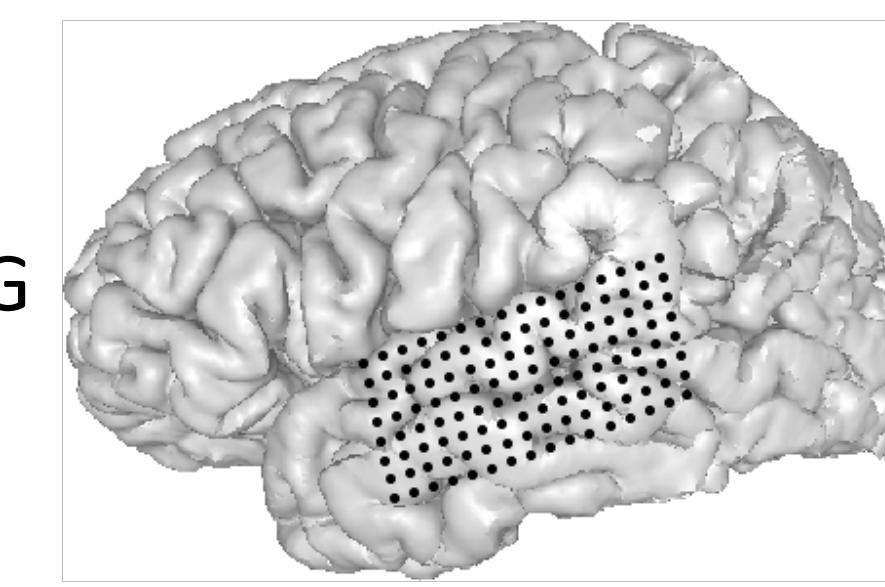
- Human STG represents lexical tone category information.
- Local STG populations are tuned to speaker-normalized pitch related features, such as relative pitch height and pitch change.
- Encoding properties in STG are largely language-independent, but population representation is influenced by language experience.

## BACKGROUND

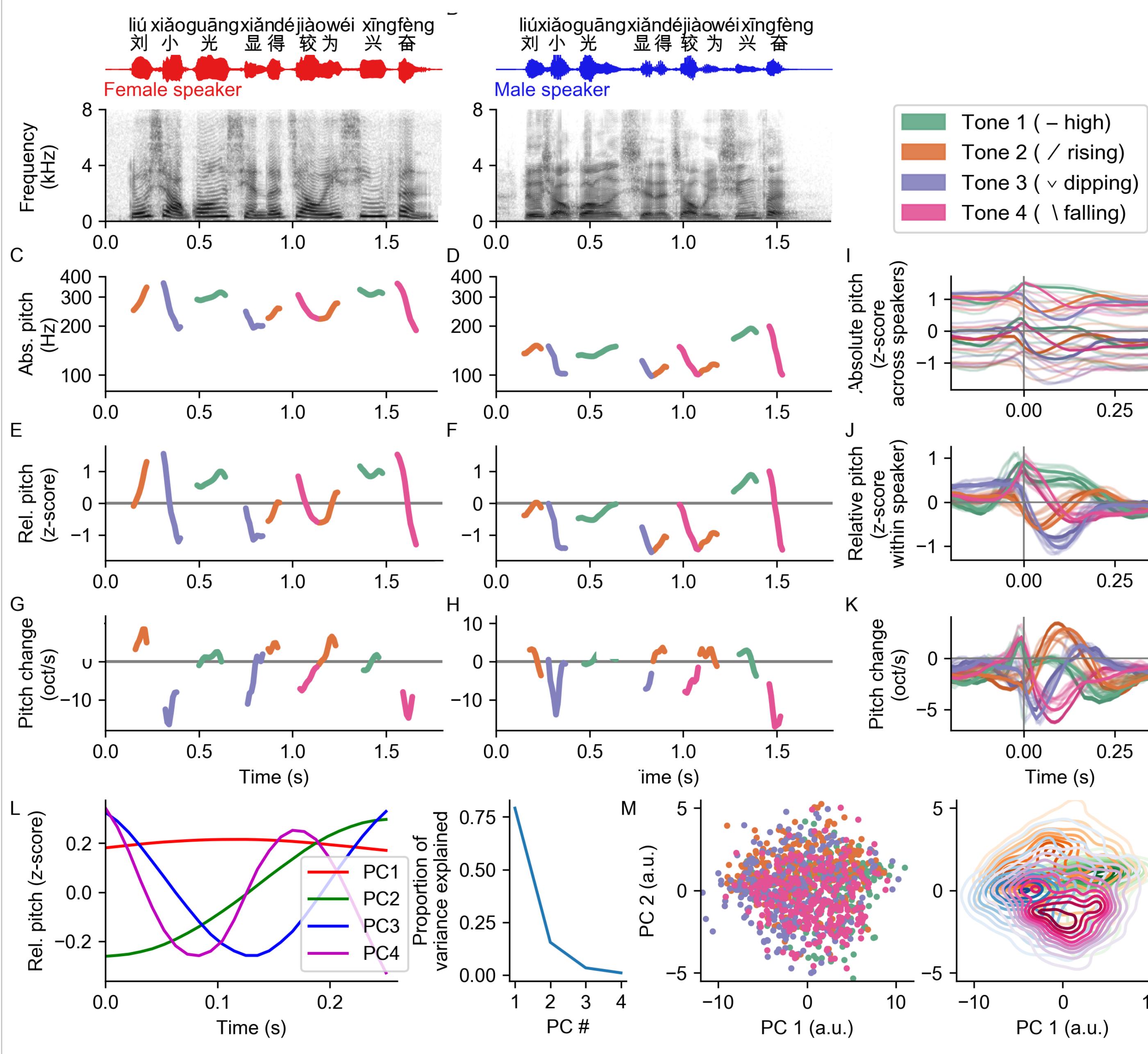
- Tonal languages use variations in pitch contour to contrast meaning.
- Large variability exists in naturalistic speech:
  - Pitch variance across different speakers;
  - Pitch variance across natural utterances.
- Behavioral studies suggest categorical perception of lexical tones.
- The neural basis of tone perception remains unclear.

## METHODS

- 10 subjects (brain tumor/epilepsy patients)
  - 7 Native Mandarin + 3 Native English speakers
- Direct Electrocorticography (ECoG) recording from STG
  - High-gamma activity (70-150 Hz)
- Listen to naturalistic Mandarin and English speech.



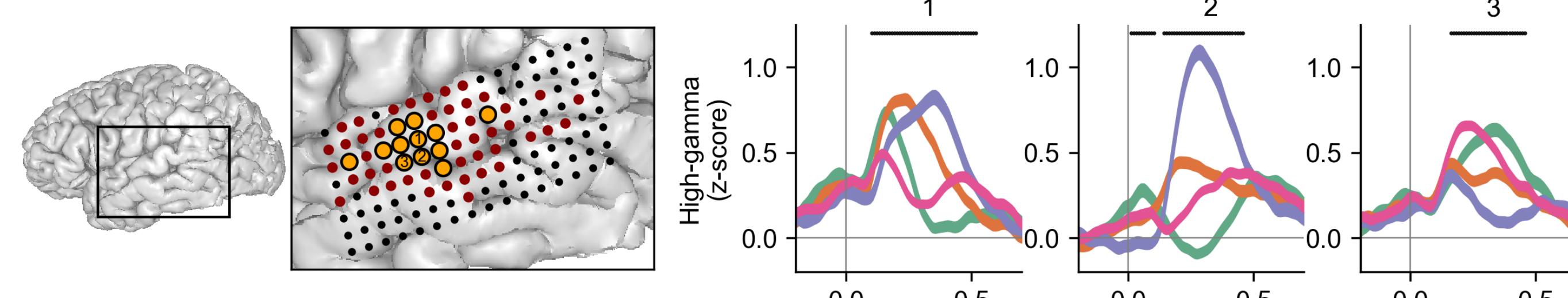
### Speaker-normalized relative pitch and pitch change are acoustic features that define lexical tones in continuous Mandarin speech.



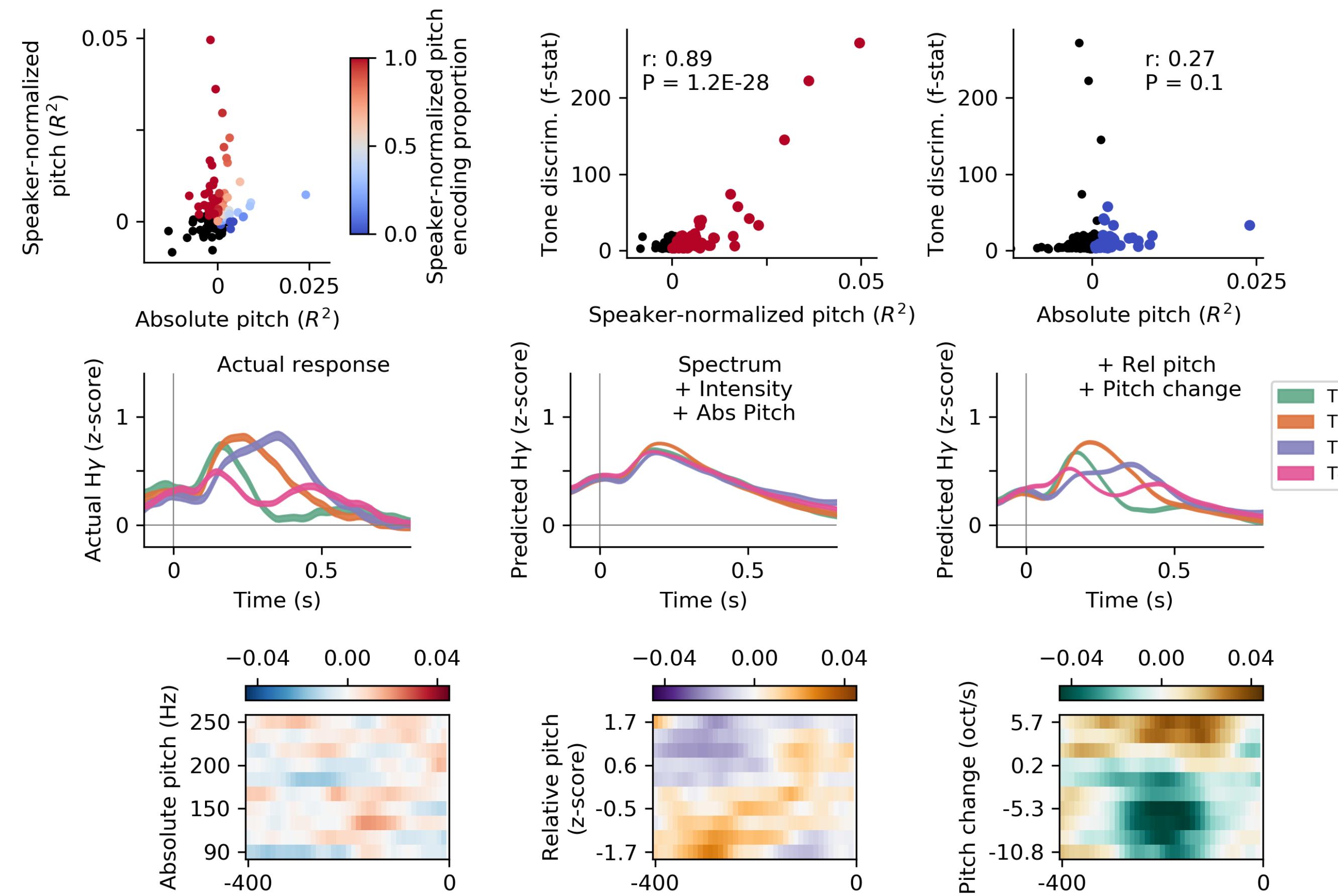
## RESULTS

### Single electrode encoding analysis

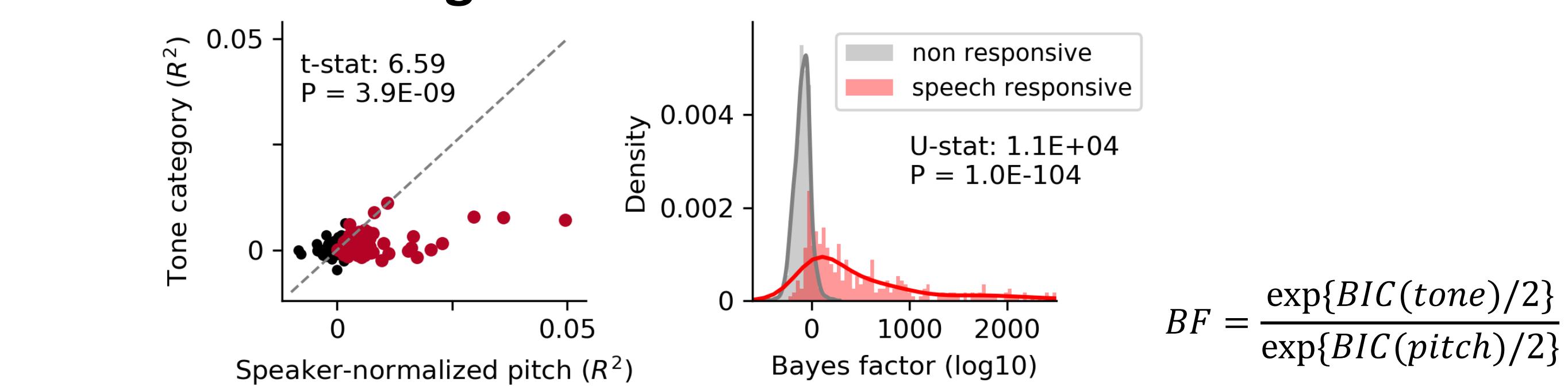
#### Lexical tones in continuous Mandarin speech evoke differential neural responses in discrete populations in STG.



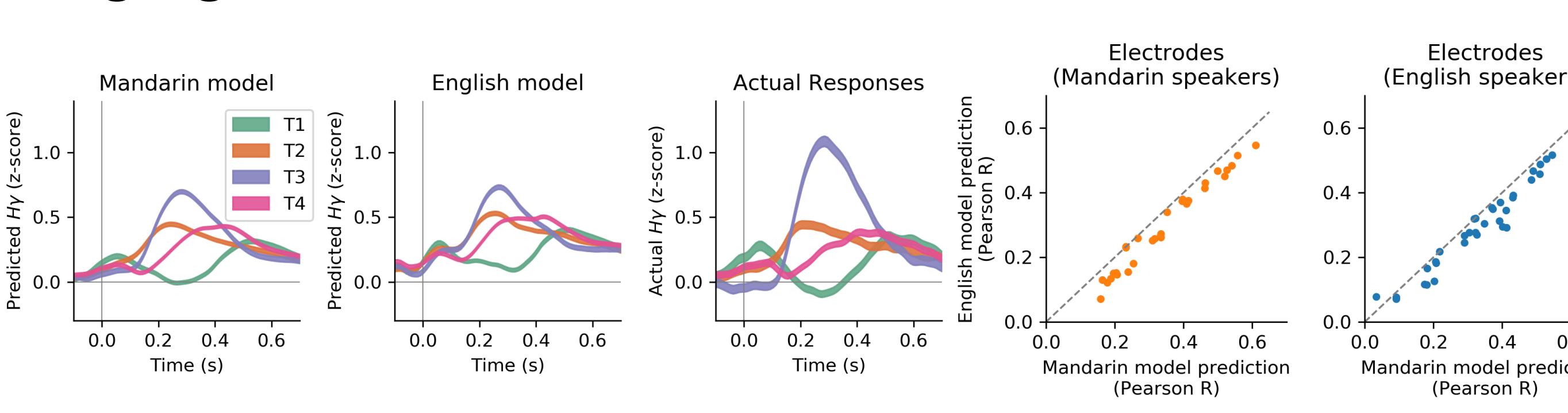
#### Neural activity in single STG electrode encodes speaker-normalized pitch features that underlie tone discrimination.



#### Neural activity in single STG electrode does NOT encode discrete tone-categories.



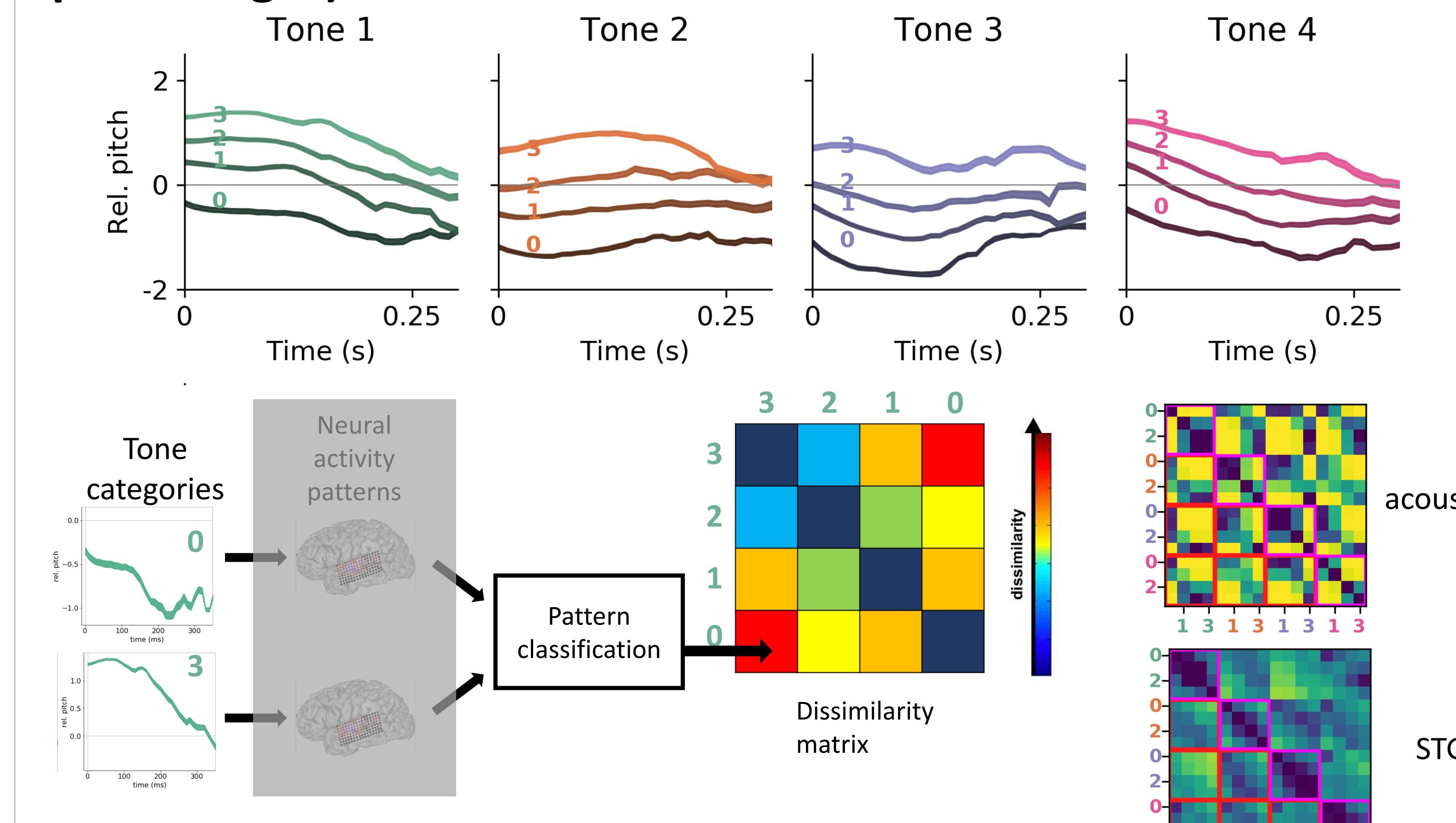
#### Single STG electrode encoding properties are shared across languages.



## RESULTS

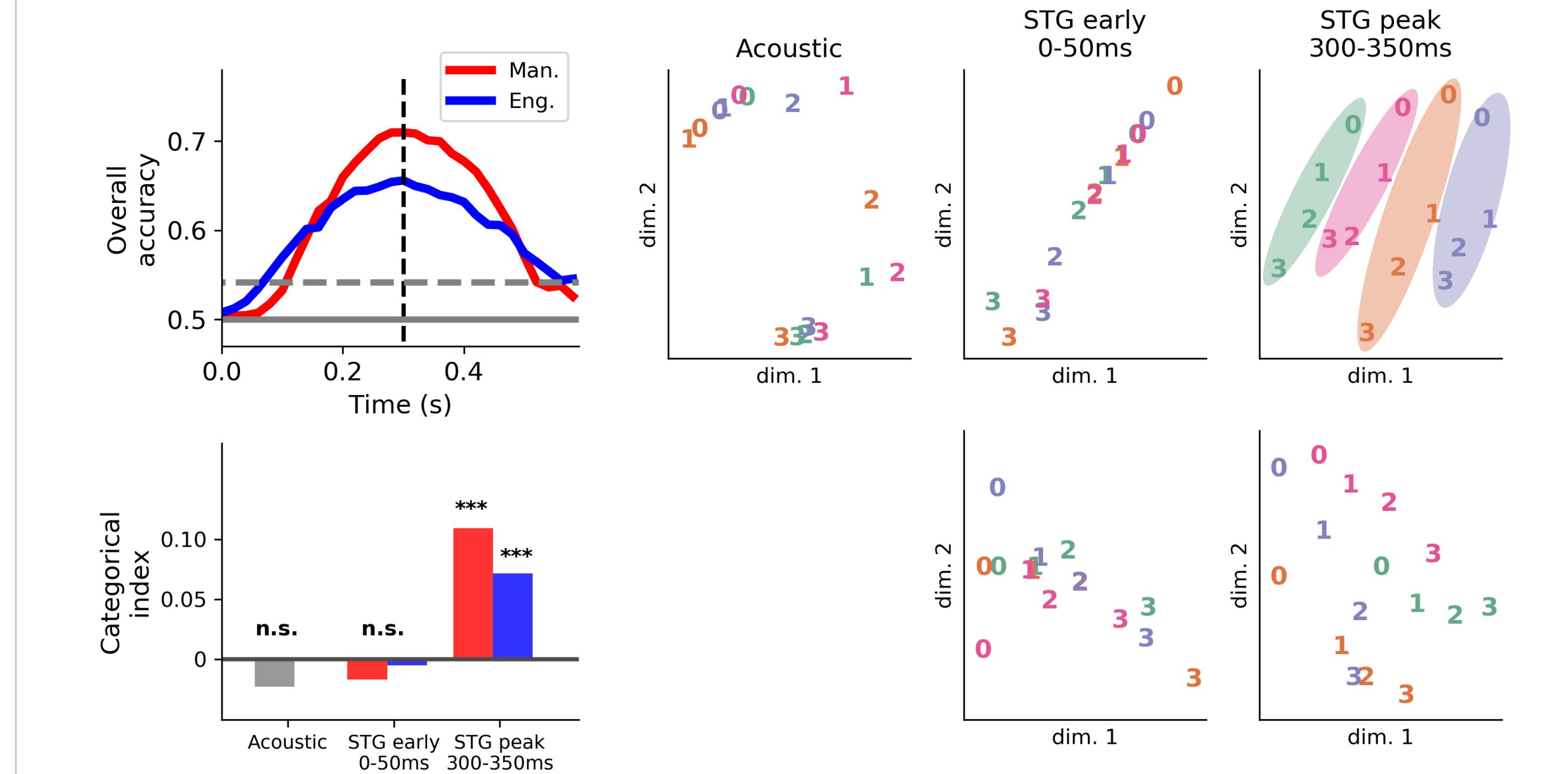
### Population decoding analysis

#### Construct a continuum of pitch contours using PC1 (mean pitch height)



Categorical index =  $\text{between tone acc.} - \text{within tone acc.}$

#### Population neural activity in human STG supports categorical representation of lexical tones.



Native Mandarin speakers show stronger categorical representation structure in the STG than native English speakers.

## REFERENCES

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## Acknowledgments

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