

Dynamic activities within cortico-limbic areas are correlated with properties of ultrasonic vocalizations

Gyu-Hwan Lee^{1,2}, Jaehyun Lee¹ and Jee Hyun Choi¹

¹Korea Institute of Science and Technology; ²Seoul National University; Email me: gh.lee@kist.re.kr; Visit us: <https://www.jeelab.net/>



Introduction

Backgrounds

Hypotheses

- Mice recognizes different frequency-modulation patterns [1].
- Rats produce two types of calls with distinct frequency-modulation patterns (flat and sinuous) which have opposite emotional valence [2].

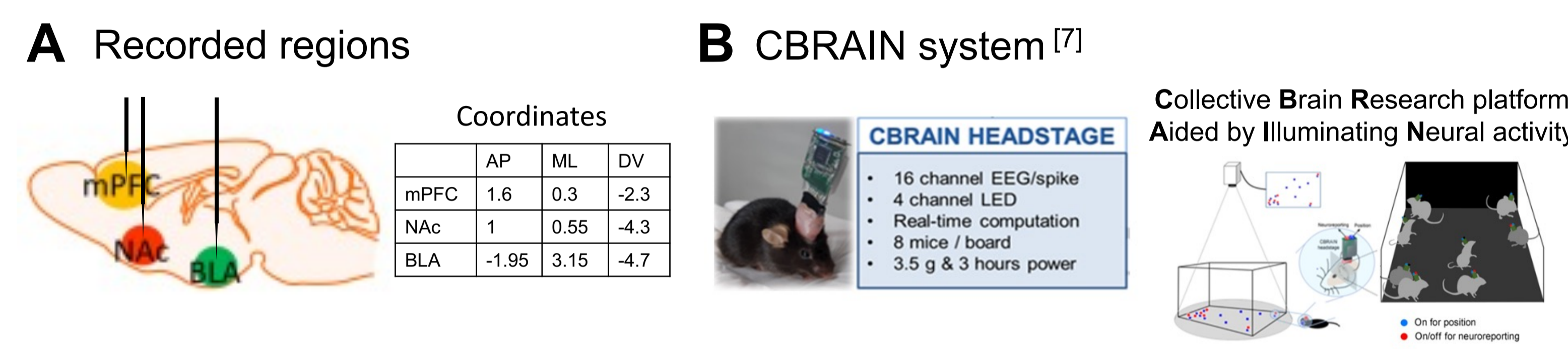
- Distinct frequency modulation pattern will exhibit distinct neural signature within the mPFC, NAc and BLA regions.

- Mouse vocalization is tightly linked to the exhalation phase of breathing [3].
- Respiration-related brain rhythm is observed in wide frontal areas [4-5].
- Phonatory movements in rhesus monkeys show theta-rhythmicity [6].

- USVs of different length will affect the theta rhythm in the frontal regions, and the interaction of theta rhythm with other frequency bands.

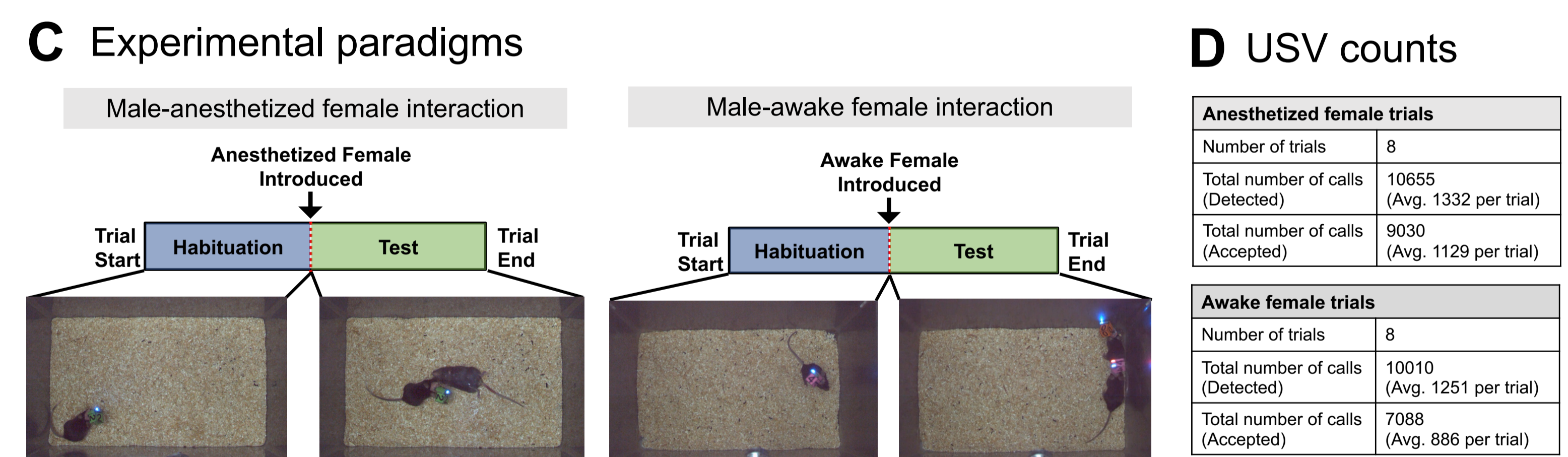
Methods

LFP Recording



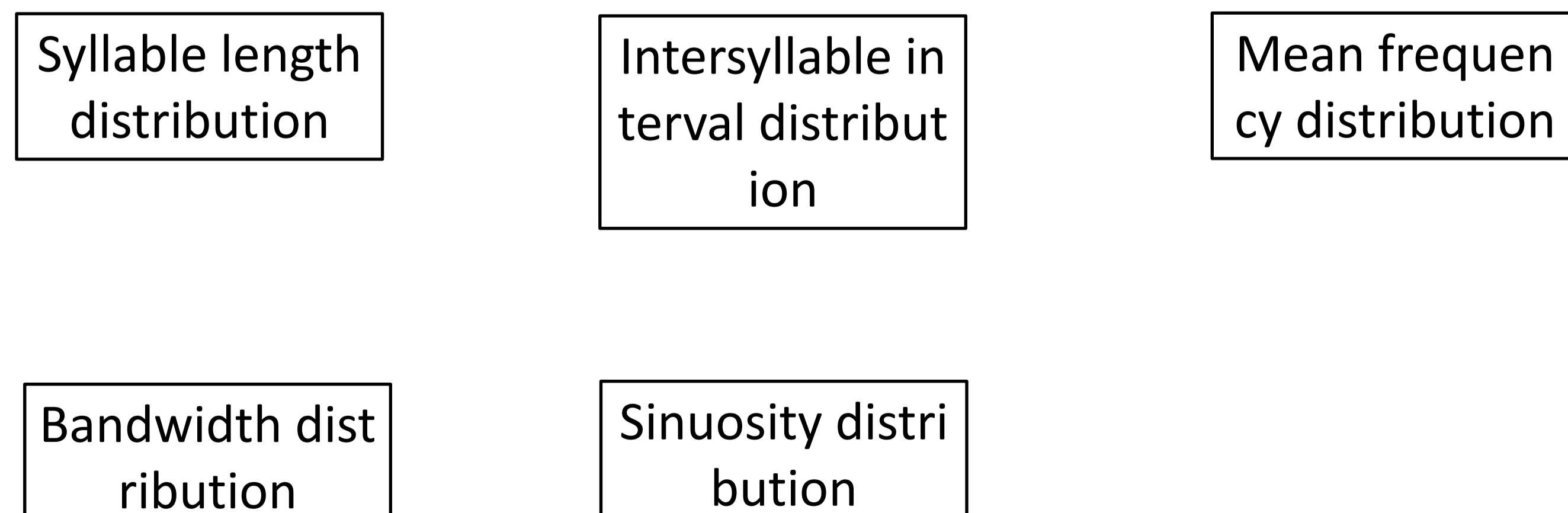
A. LFP was recorded from three brain regions: mPFC, BLA and NAc. B. CBRAIN system was used to acquire brain recordings from freely-moving mice.

Experiment



C. USV was elicited by exposing males to either awake or anesthetized females. Ultrasonic vocalizations were recorded at 300 kHz. D. Syllables were detected by neural network [8] and the detections were refined using custom scripts.

Results 1. Properties of produced USVs

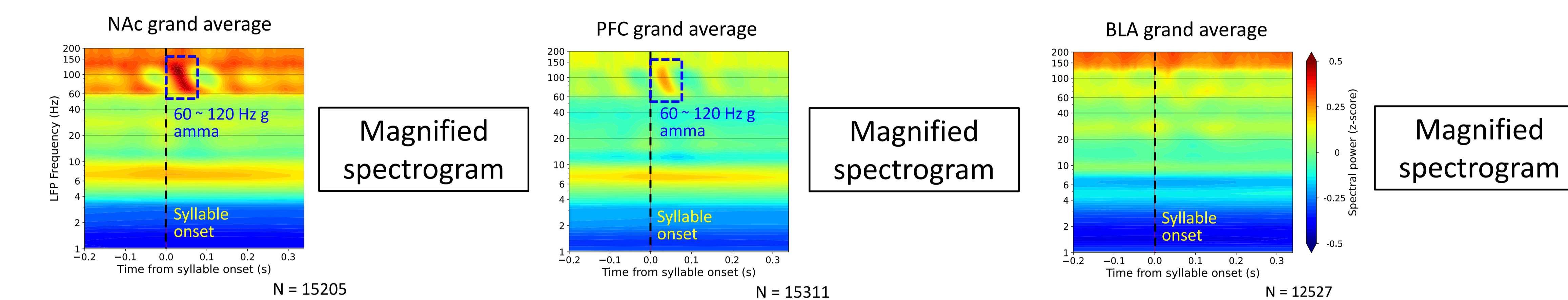


Results 2. Overall effect of USV production on LFP

A Power spectral density (PSD) with and without USV

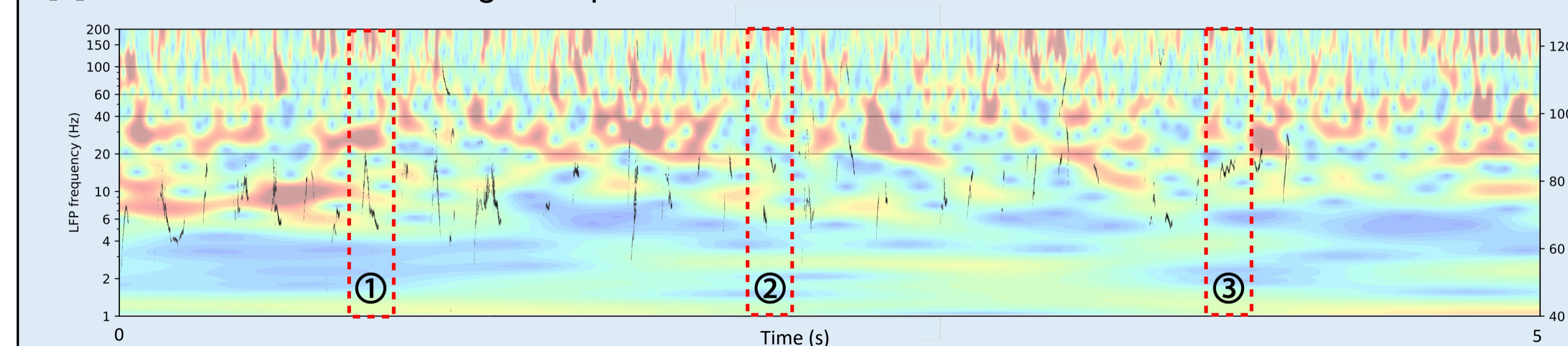


B Grand average spectrograms of USV epochs

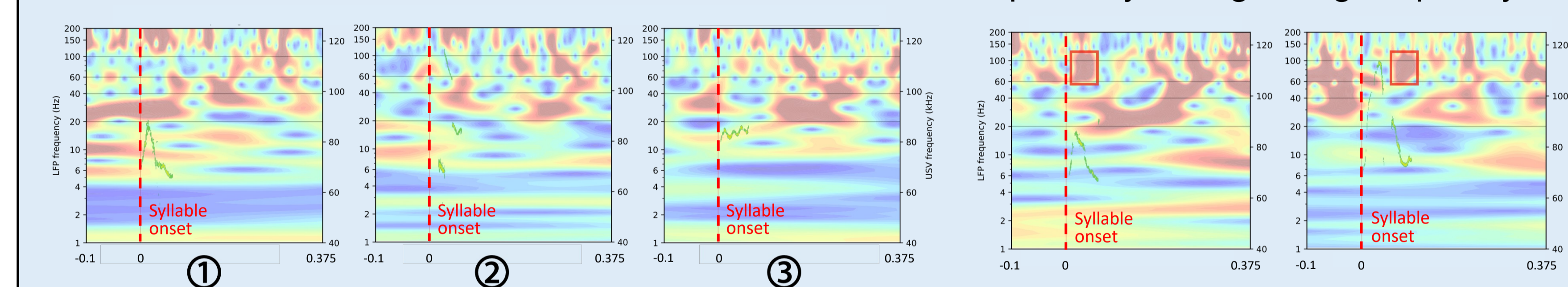


Results 3. Effect of frequency modulation

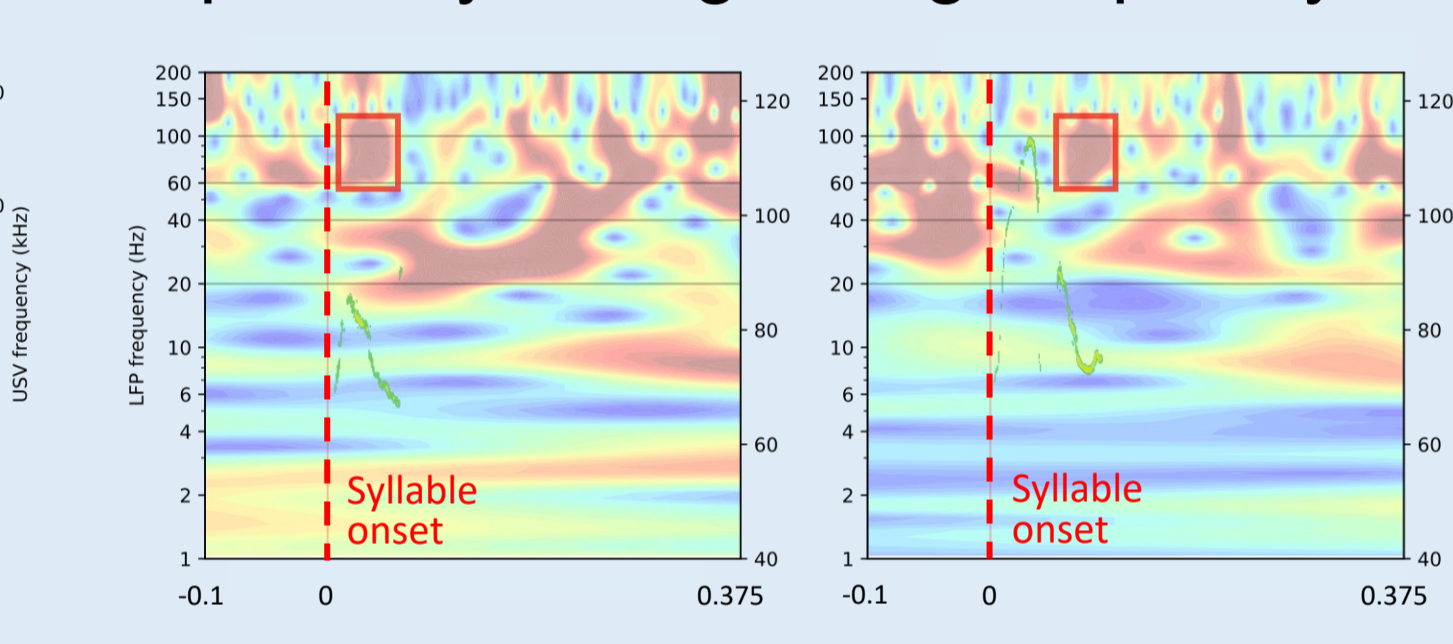
A NAc LFP activities during USV production



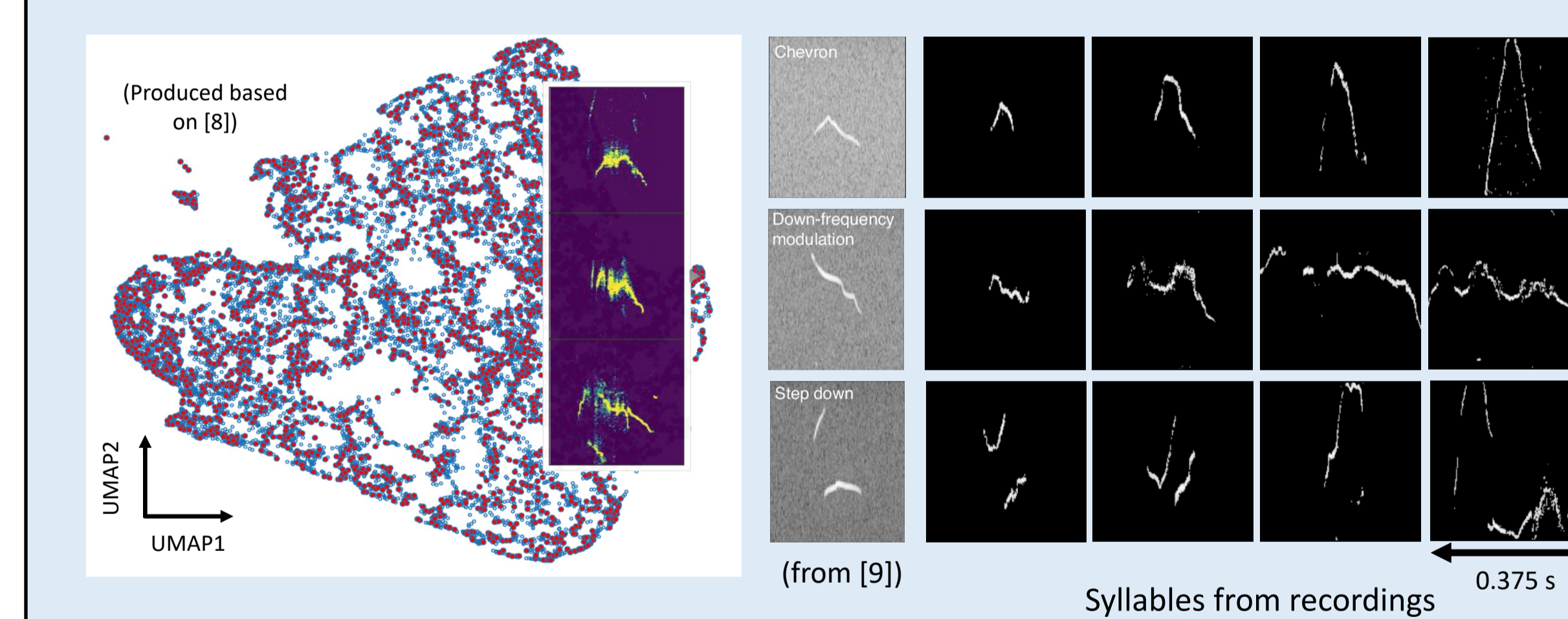
B LFP patterns accompanying USV syllables



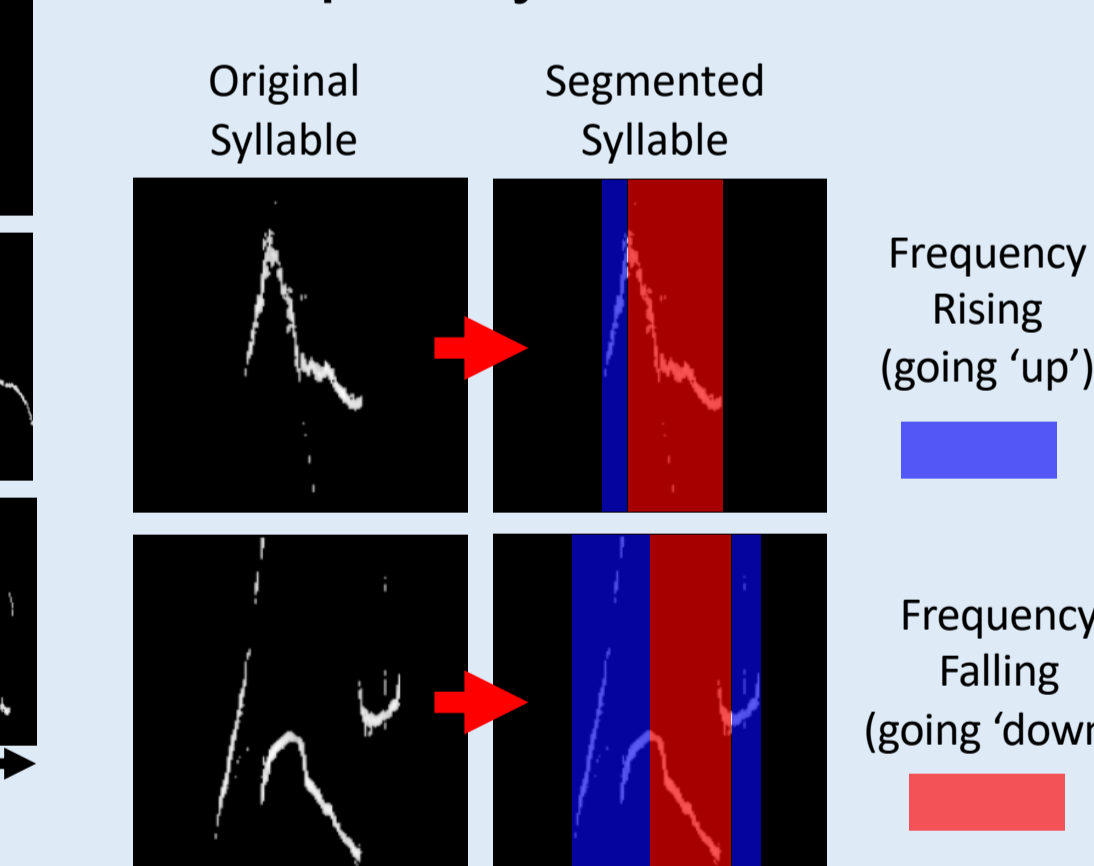
C γ activity during falling frequency



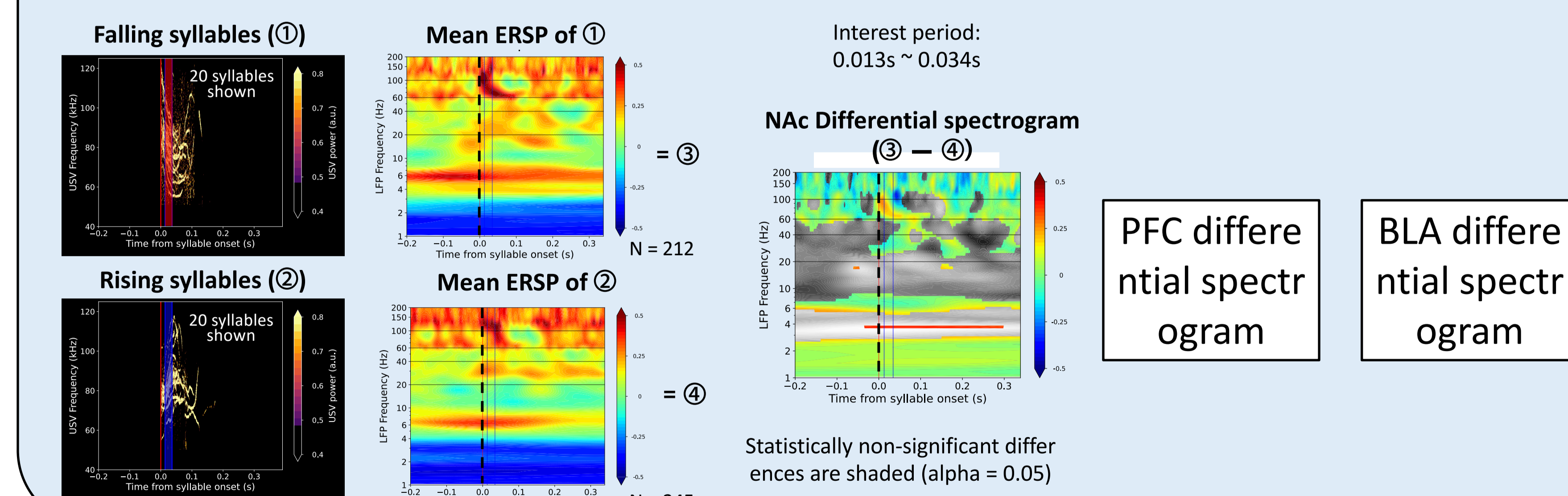
D Difficulty of USV classification



E Syllable segmentation by frequency modulation



E Rising/Falling syllables show different spectral perturbation patterns

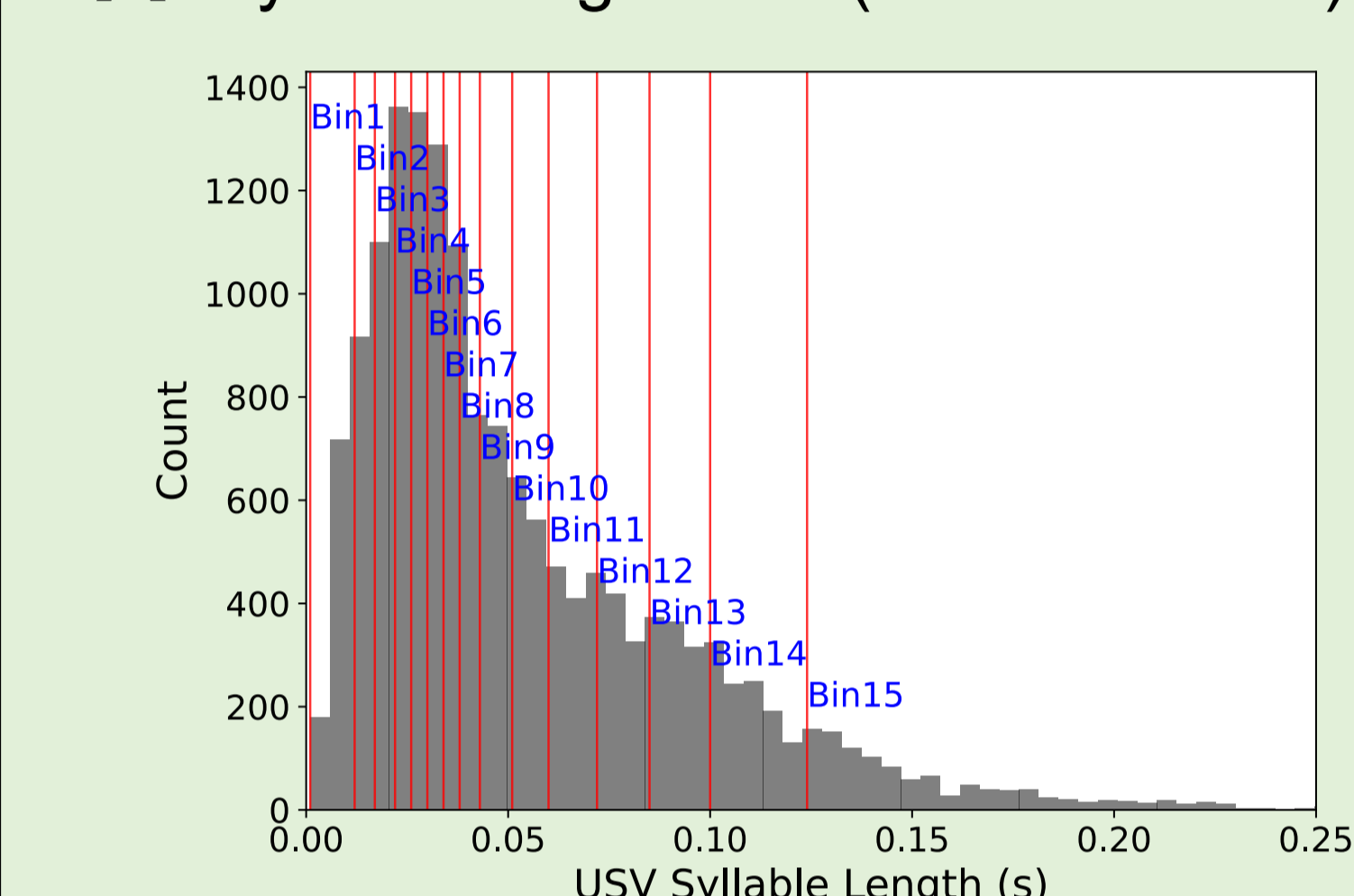


Part summary

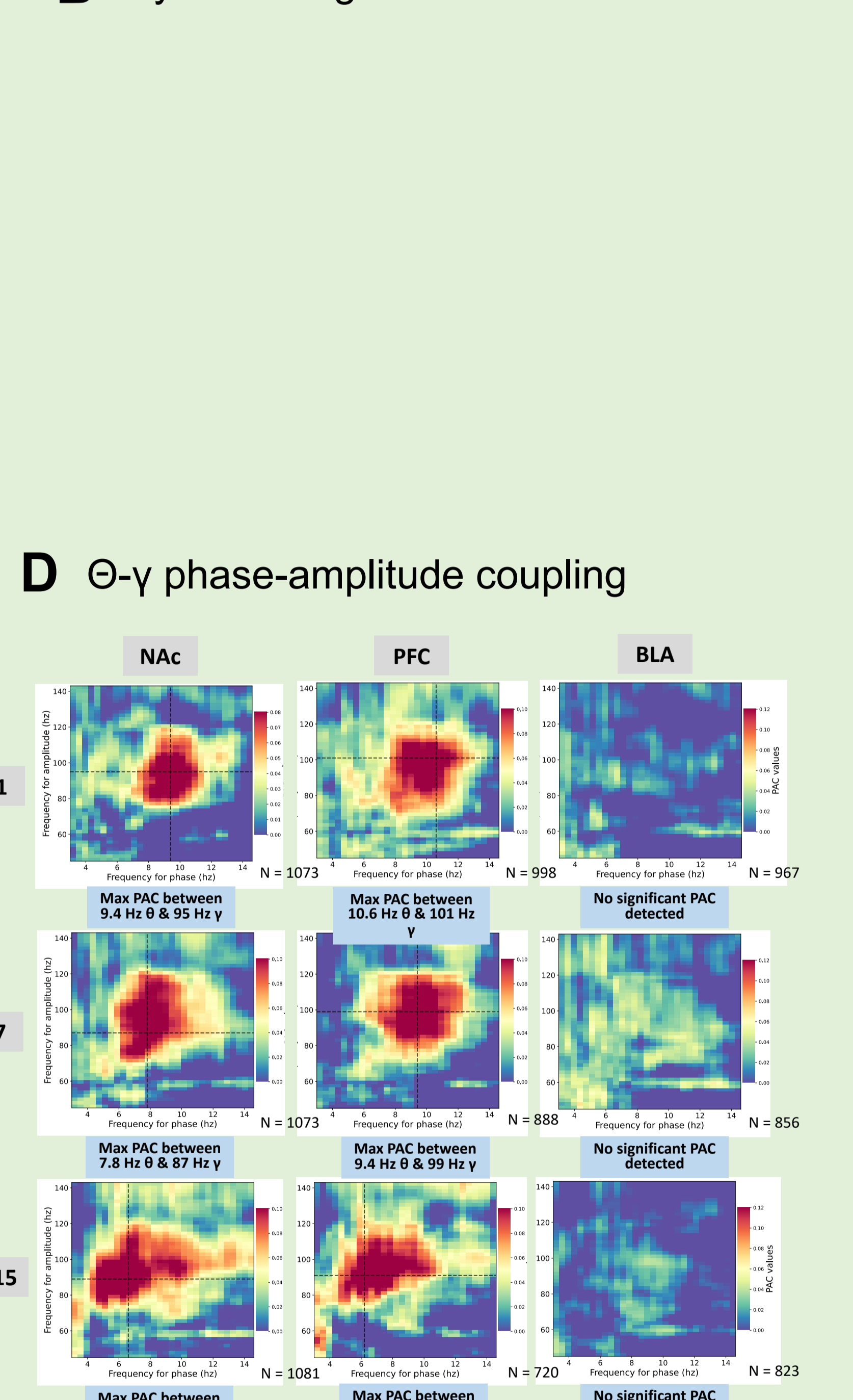
Future directions

Results 4. Effect of syllable length

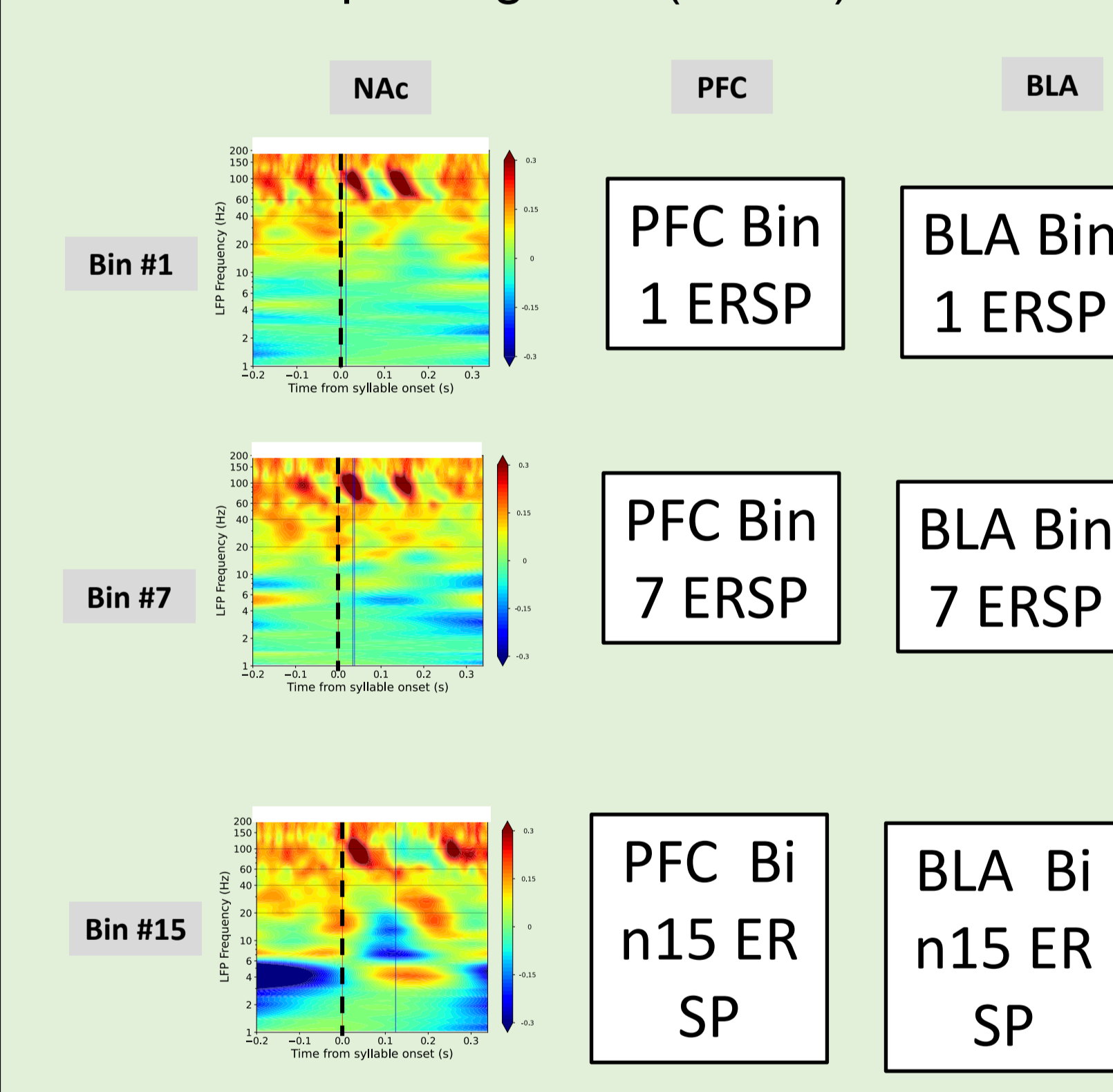
A Syllable length bins (Bin 1 ~ Bin 15)



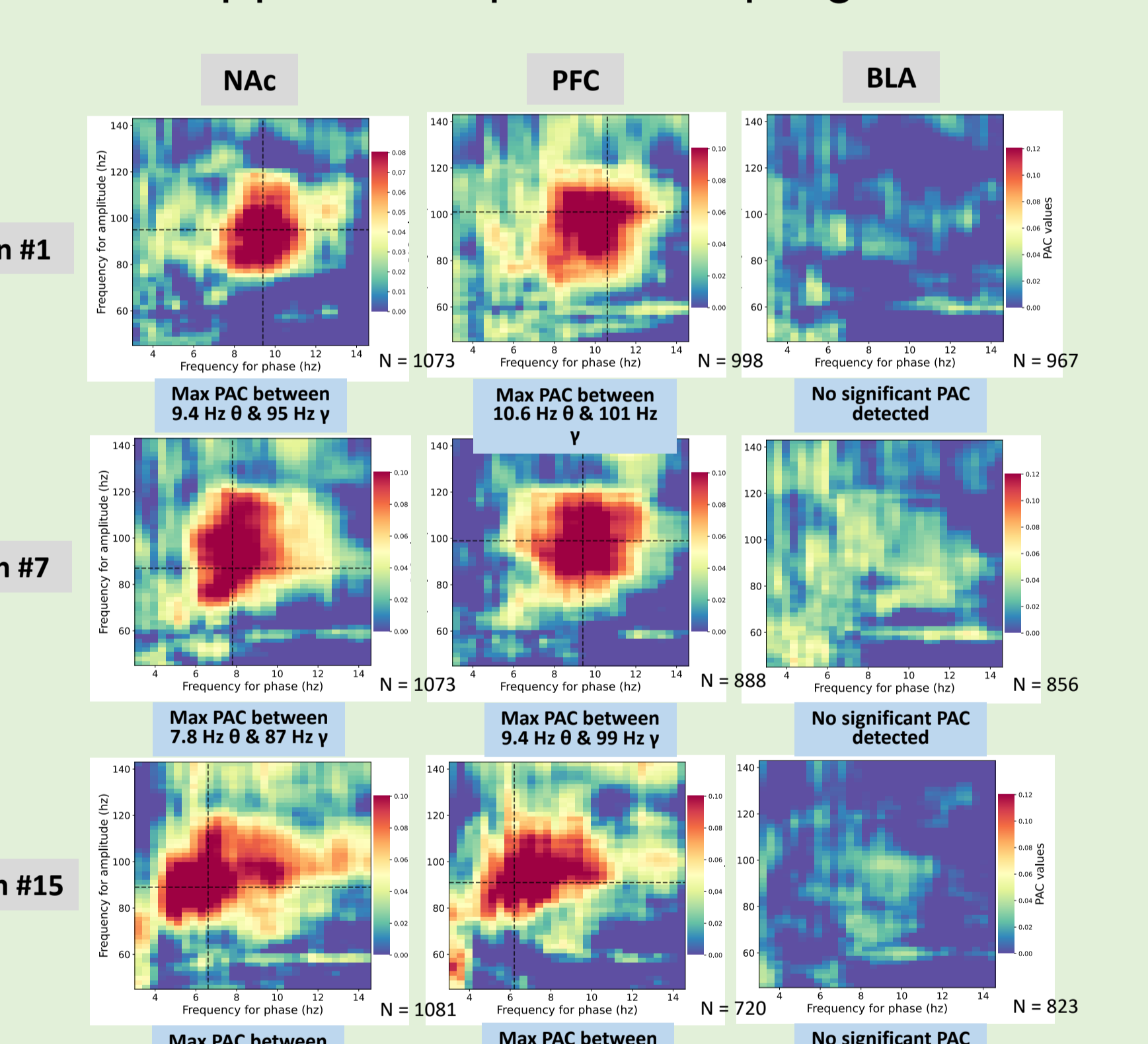
B Syllable length bins information



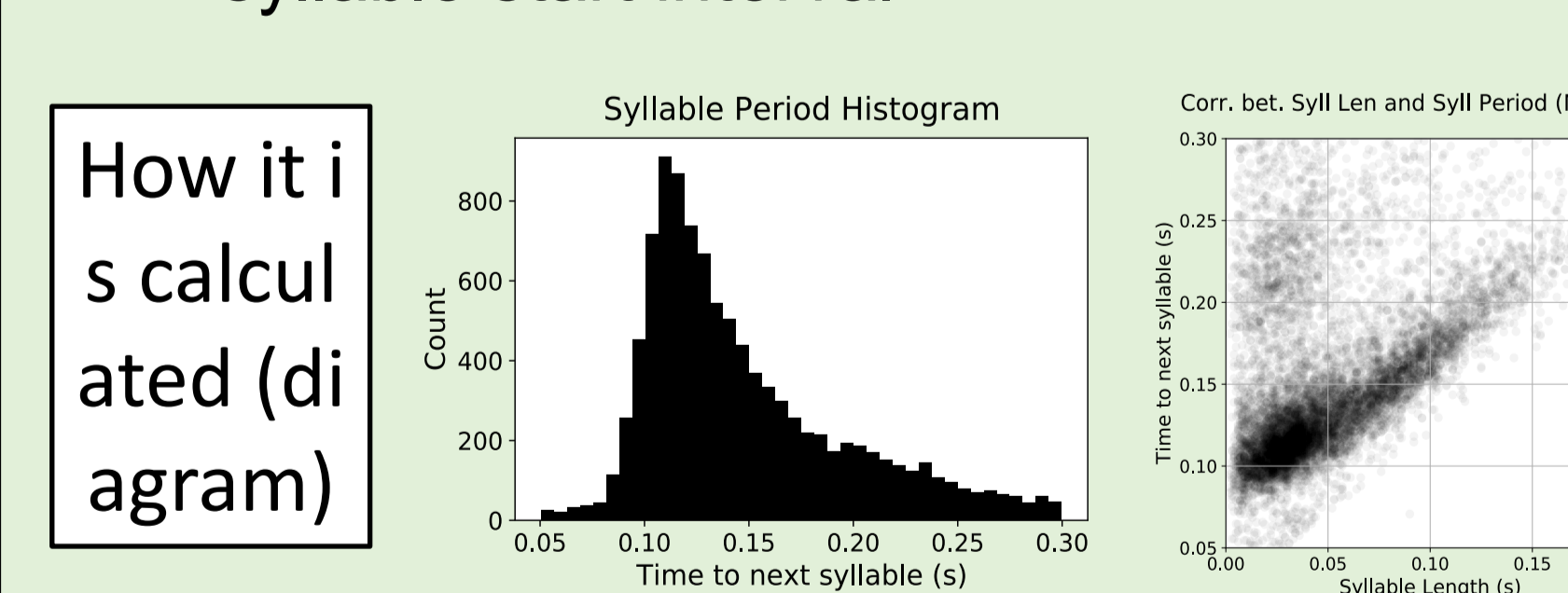
C Mean spectrograms (ERSP)



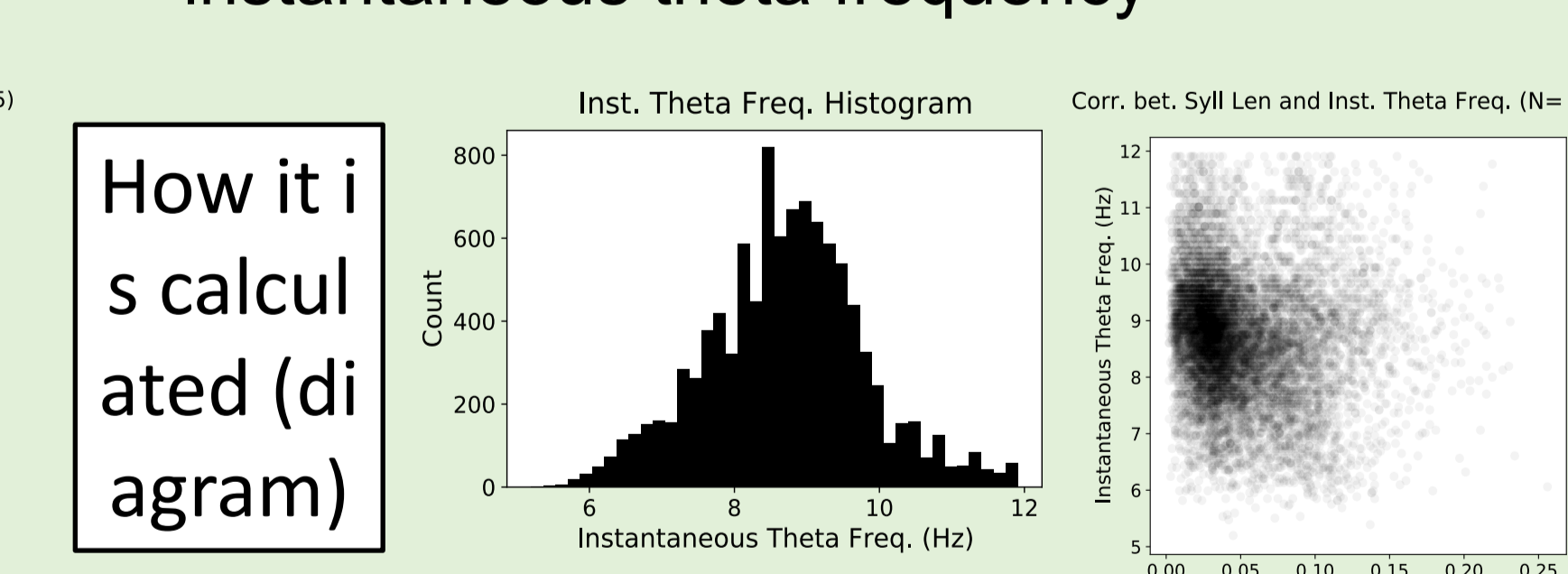
D Θ - γ phase-amplitude coupling



E Correlation between syllable length and syllable start interval



F Correlation between syllable length and instantaneous theta frequency



Part summary

Acknowledgement

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References