



Analysis of Aperiodic EEG Components Across Task and Population Conditions

Samanyu S. Kunchanapalli, Alana M. Campbell
University of North Carolina at Chapel Hill

INTRODUCTION

The purpose of this study is to explore spectral parameters of the EEG signal in different populations.

Traditional EEG analysis methods focus on oscillations, however recent work highlights the importance of aperiodic features, slope and offset.

Here we quantify both the offset and slope in a) healthy adults and b) healthy and nicotine exposed infants to determine the degree to which these features are sensitive to different conditions.

METHODS

EEG was recorded in two studies

Study 1: eXe, n = 31 18-50yo.

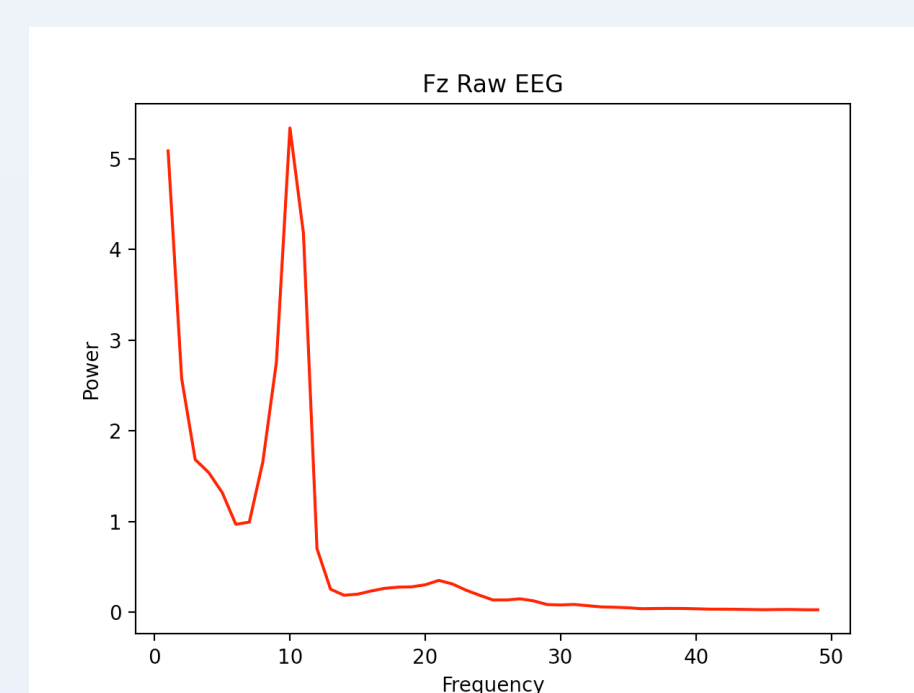
EEG recorded via 64 channel BioSemi during 2.5 minutes of continuous EEG with the eyes open (EO) versus eyes closed (EC) conditions.

- EC known to have elevated alpha (8-12Hz) activity.
- Explore relationship between alpha peaks and aperiodic features

Study 2: PNE, ~4month old infants exposed to nicotine prenatally (PNE; n = 12) or control (CON; n=8).

EEG recoded via 128 channel EGI during auditory oddball task.

For both studies, data were preprocessed to remove artifact, high-pass filter, identify and remove bad channels, interpolate those channels, use a wavelet to decompose the signal.



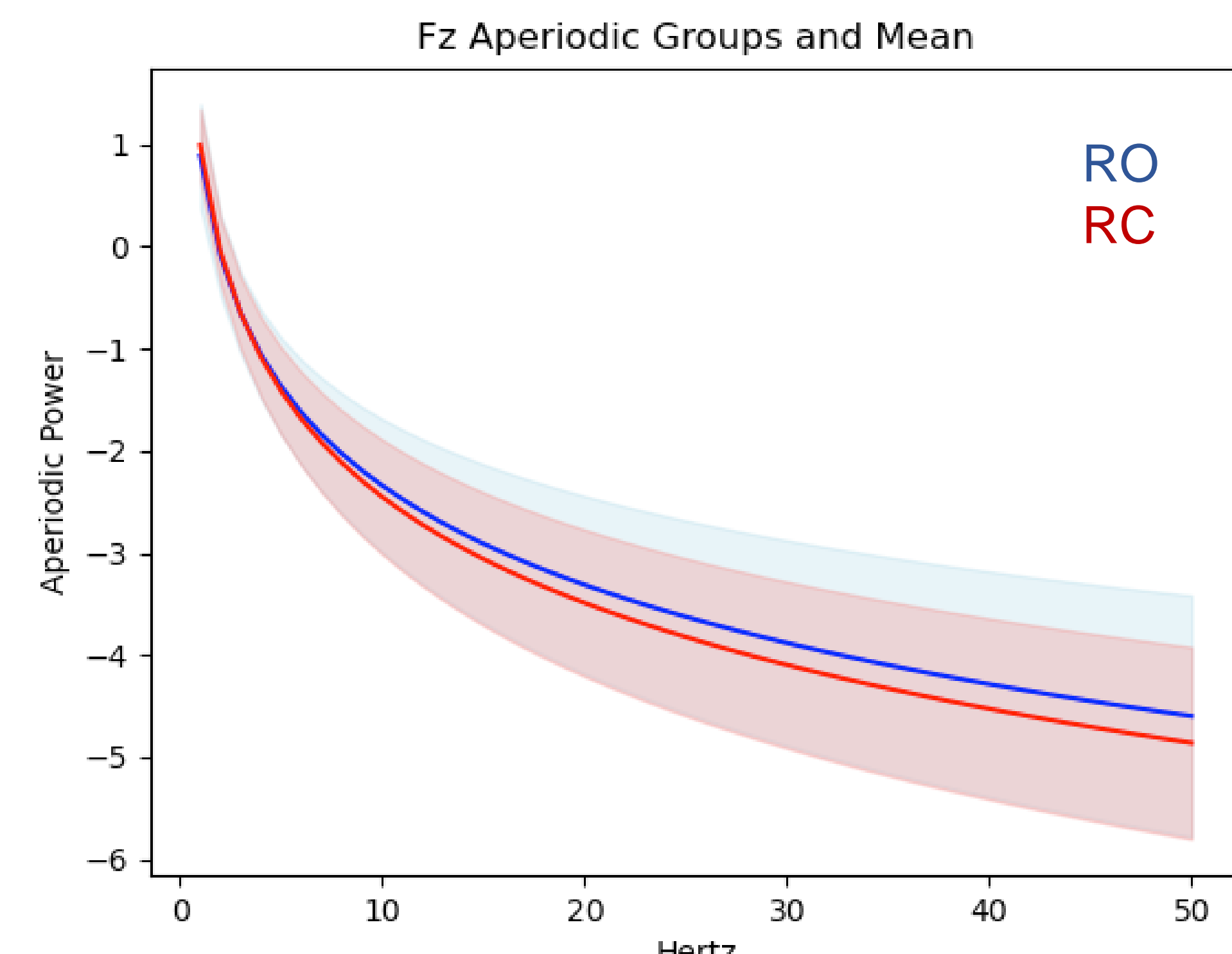
Identify peaks in ranges of interest:

Study 1: eXe alpha activity (8-12Hz) most robust in EC condition.

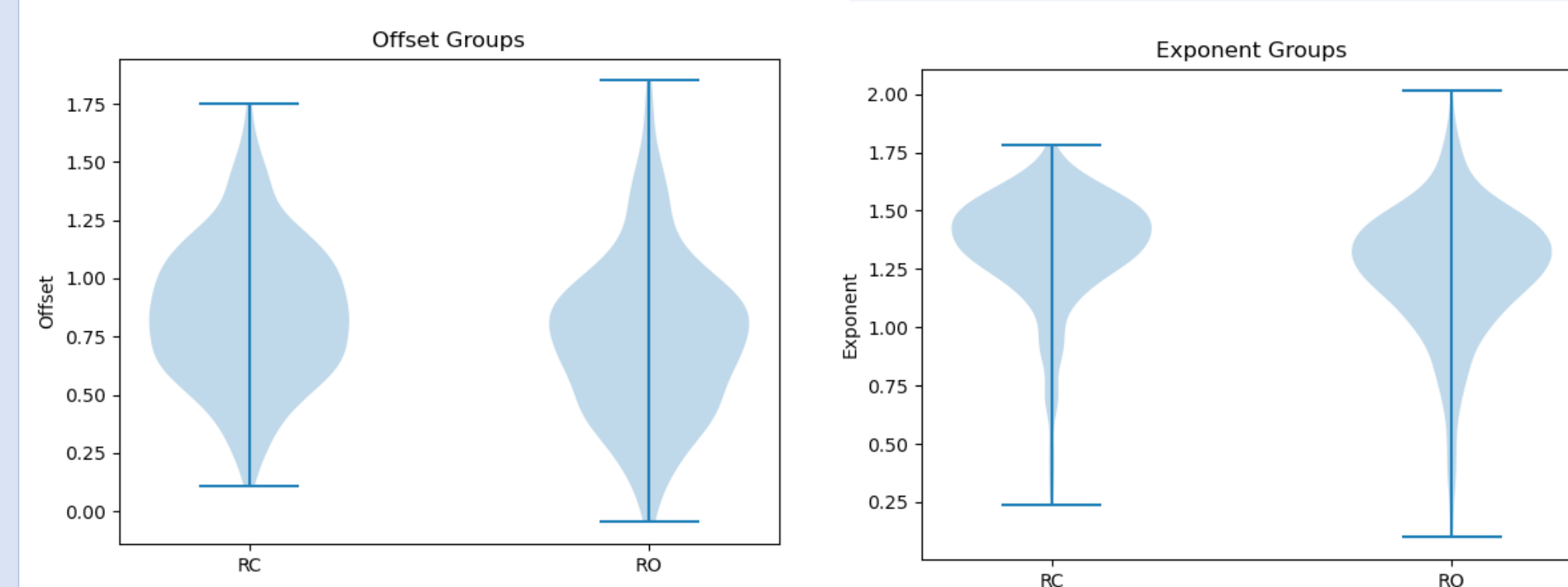
Study 2: PNE – theta (3-6Hz) and alpha (6-9Jz) most prominent for infants.

Peaks fitted by gaussians.

eXe HEALTHY ADULTS AT REST

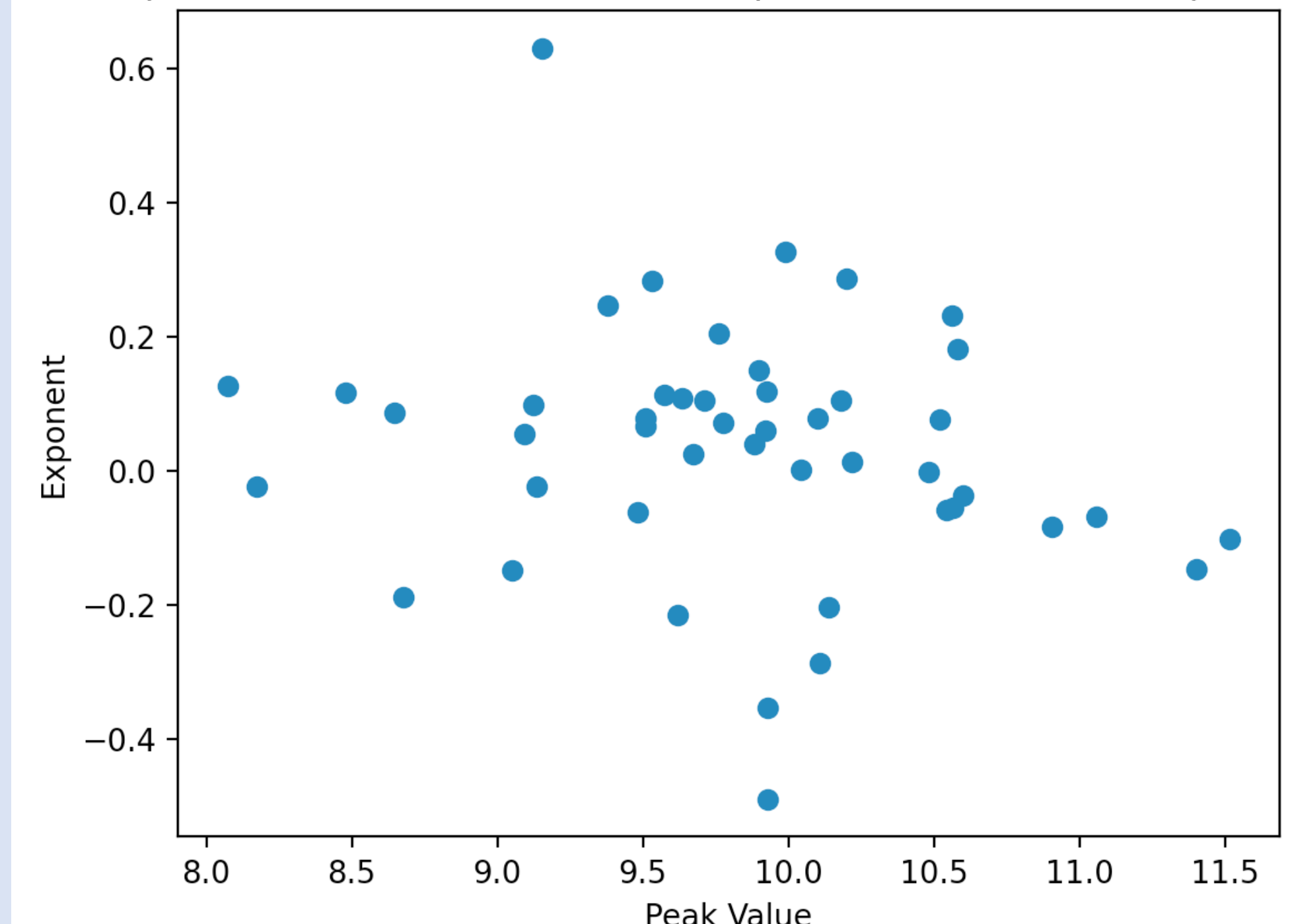


- **Slope shifts between RO and RC conditions: RC is steeper**
- **Offset reduced in RO compared to RC**

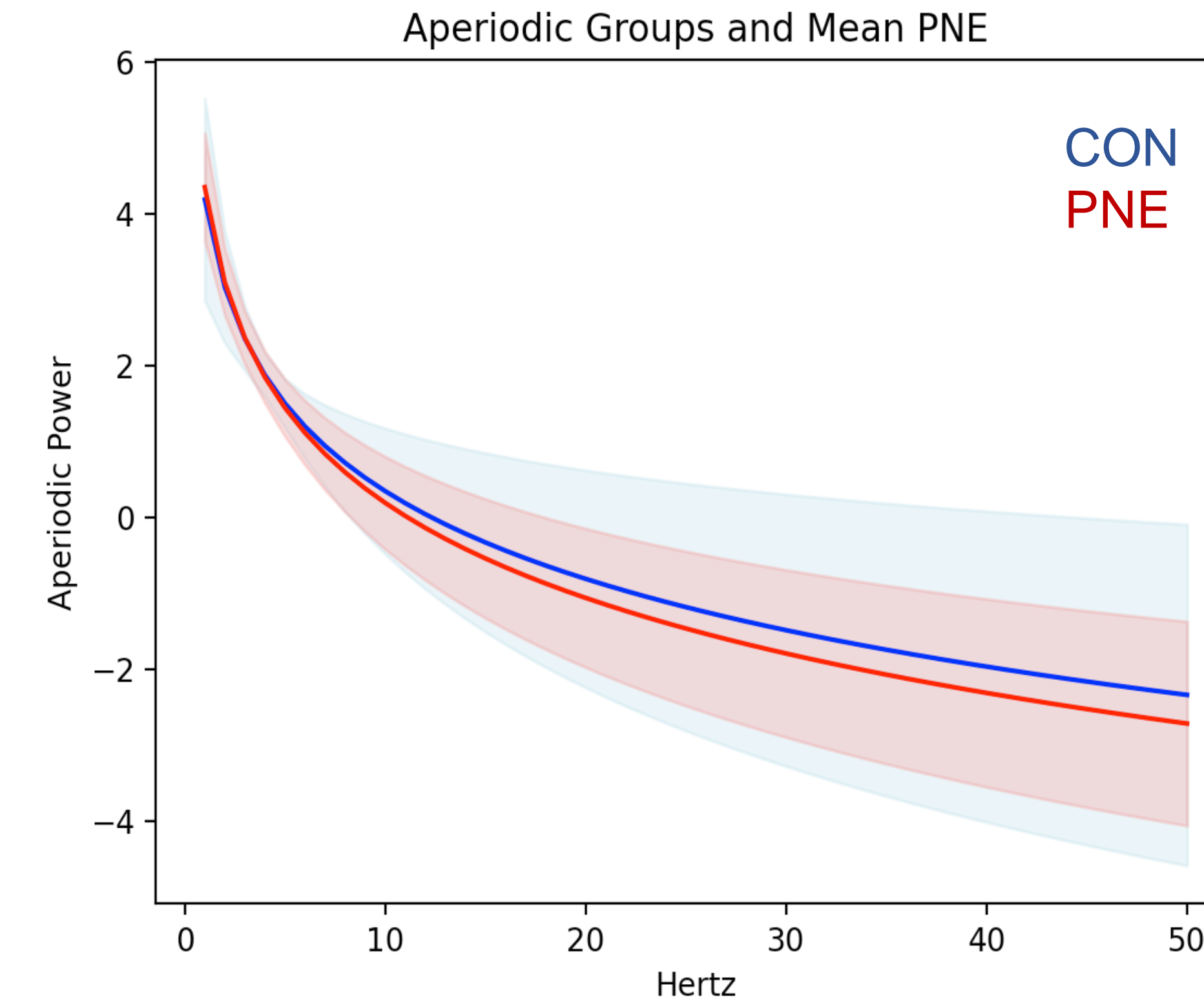


eXe	RC	RO	P-Value
Offset	0.86	0.76	1.84e-06
Slope (Exponent)	1.30	1.27	3.25e-07

Exponent Difference Between Groups in Relation to Max Alpha Peak



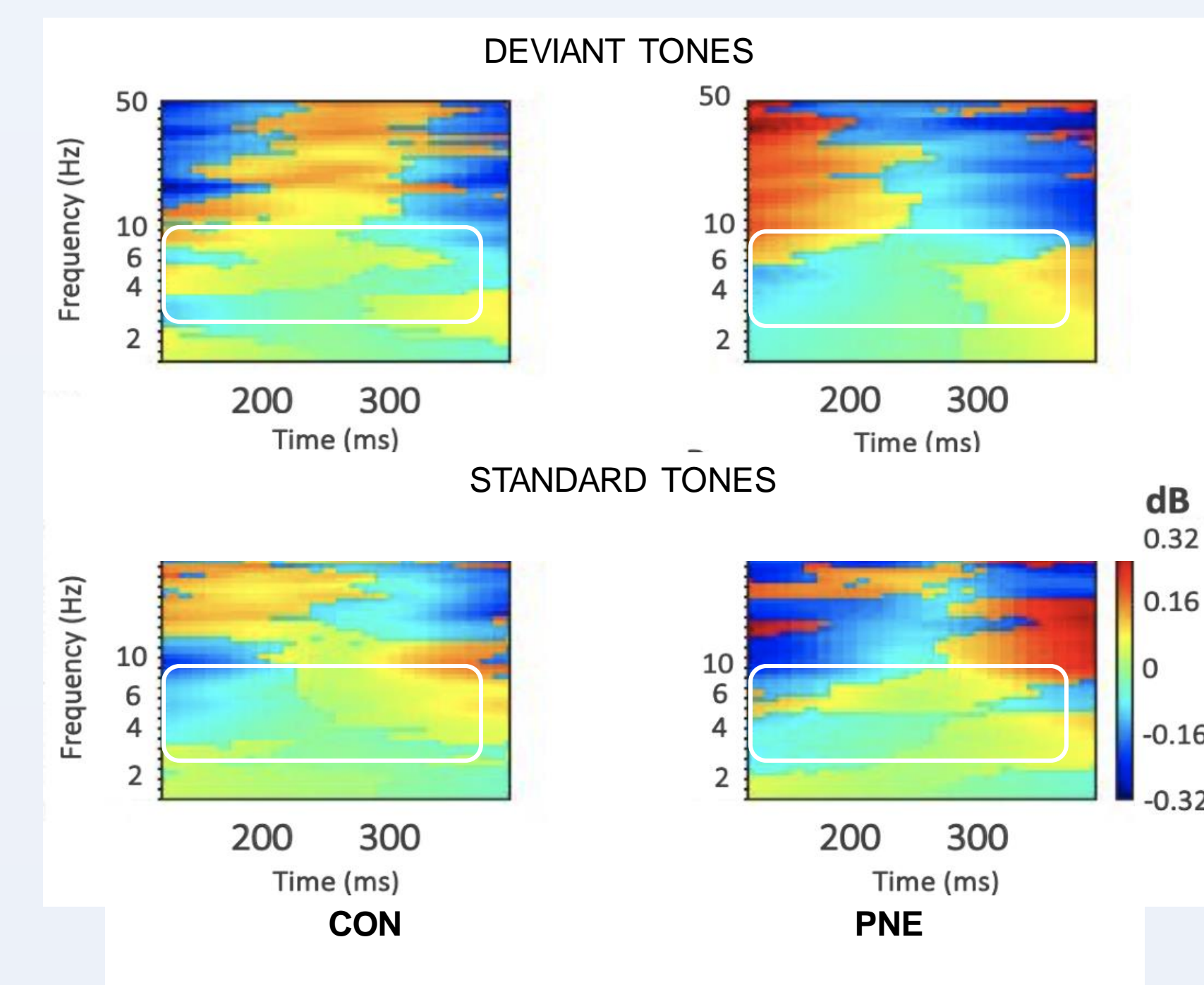
PNE INFANTS



PNE	CON	PNE	P-Value
Offset	4.19	4.35	0.54
Exponent	1.68	1.81	0.49

- **No differences between groups in the slope of offset, aperiodic features**

PNE	CON	PNE
% with Alpha Peak	0.13	0.0
% with Theta Peak	0.38	0.33



- **Deviant: theta PNE < CON ; PNE enhanced alpha**
- **Standard: theta PNE > CON**

CONCLUSIONS

- Study 1: eXe
 - First to document aperiodic shift in resting state brain states of EEG
 - Aperiodic shifts are not significantly related to established periodic activity.
 - Possibilities
 1. Distinct underlying mechanisms
 2. Related mechanism that is not dependent on spectral power
- Future work would further examine these possibilities.
- Study 2: PNE
 - First to examine aperiodic activity in infants exposed to nicotine.
 - Aperiodic activity did not differ between groups.
 - However, dataset is small and has high variability
 - Task based aperiodic activity may underscore and modify interpretation of periodic activity.
 - Future work should explore in a larger sample
 - Periodic activity, and consistency of periodic activity, does differ.
 - Periodic activity has established developmental trajectory, which may differ between groups.
 - Future work should examine aperiodic trajectories

Combined these studies highlight the unique utility of aperiodic features.

REFERENCES

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