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# EEG theta/beta ratio correlates positively with inattention and memory problems in ADHD and controls

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## Introduction

Attention-deficit/hyperactivity disorder (ADHD) affects ~5% adults worldwide.<sup>1</sup> Brain electrical activity at rest, measured by EEG, may clarify the pathophysiology associated with ADHD and its heritability. Power in theta frequency band and in theta/beta ratio is shown to be increased in ADHD relative to healthy participants.<sup>2,3,4</sup> Little is known about the electrophysiological patterns in unaffected first-degree relatives, and their relationship to



### DOES POWER IN EEG FREQUENCY BANDS DIFFER BETWEEN ADHD, FIRST-DEGREE RELATIVE AND CONTROL PARTICIPANTS ? ARE EEG POWER VALUES ASSOCIATED WITH CONNERS' ADULT ADHD RATING SCALES (CAARS) SCORES ?

## Method

45 unmedicated ADHD (M=27 years), 35 unaffected first-degree relatives (M=37 years) and 36 healthy controls (M=27 years) **Participants:** 

- Resting-state 64-channel EEG, 3-minute eyes-open (RSEO) and 3-minute eyes-closed (RSEC) conditions **Procedure:** 
  - Absolute & relative power in delta (1-4 Hz), theta (4-8 Hz), alpha (8-13 Hz), beta (13-30), gammalow (30-60 Hz) and gammahigh (30-90 Hz) frequency bands, and the theta/beta ratio
  - Factor explaining most variance was extracted for each of the frequency bands and theta/beta ratio with PCA
  - Conners' Adult ADHD Rating Scales (CAARS)<sup>5</sup>

Comparison of absolute and relative power in frequency bands and ratios over the scalp between groups (ANOVA) **Data Analysis:** 1)

> Correlation between EEG and CAARS subscale scores 2)

## Results

1) Comparison of EEG between ADHD, first-degree relatives and controls

ADHD differed from first-degree relatives and controls *CResting-state eyes closed* in absolute theta, alpha and delta power, and in relative beta and gamma<sub>low</sub> power.

#### 2) Correlation between EEG and CAARS

RSEO theta/beta ratio over frontal region correlates with inattention and memory problems in ADHD participants.

#### Resting-state eyes open

alpha - absolute power:







beta - relative power:



theta – absolute power:



#### beta – relative power:











Inattention and memory difficulties were associated with RSEO absolute power over fronto-central areas in ADHD participants and RSEO relative power over frontal and posterior regions ADHD and control participants.

theta (ADHD): 1<sup>st</sup> PC accounts for 73.1% variance
theta (control): 1<sup>st</sup> PC accounts for 35.5% variance
alpha (ADHD): 1<sup>st</sup> PC accounts for 79.5% variance
delta (ADHD): 1<sup>st</sup> PC accounts for 28.2% variance
beta (ADHD): 1<sup>st</sup> PC accounts for 60.8% variance



References

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# Conclusions

- Electrophysiological activity at rest differed between ADHD and unaffected first-degree relatives and controls.
- First-degree relatives and controls did not differ in EEG activity patterns.
- Difficulties in attention and memory were associated with neurophysiological activations and theta/beta ratio in ADHD.
- Electrophysiological measures may have utility as a neuromarker for ADHD symptomology.