Disentangling Tourette syndrome and ADHD using electroencephalography and functional connectivity

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INTRODUCTION

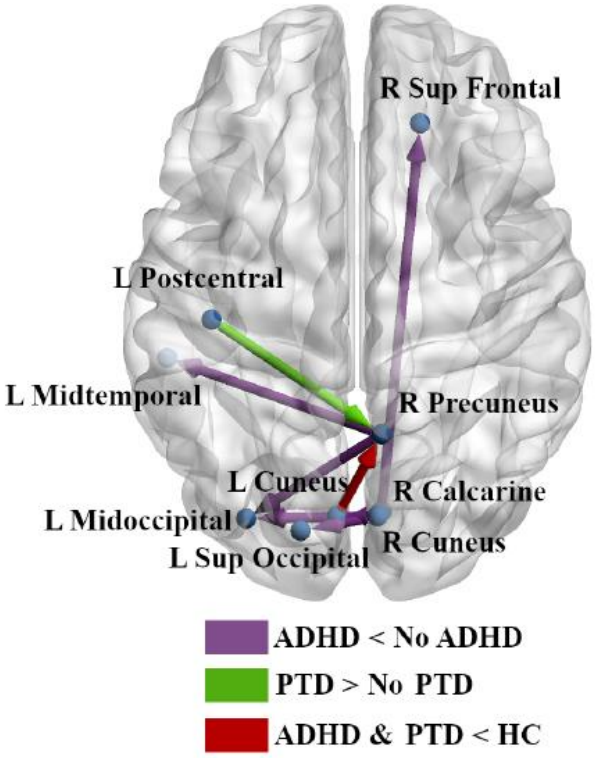
- Tourette syndrome (TS) and attention deficit hyperactivity disorder (ADHD) frequently co-occur.
- Children with TS who also have a diagnosis of ADHD are more likely to have impairments in cognitive function and more psychosocial and behavioral difficulties.

INTRODUCTION

- It remains unclear how the neurobiological underpinnings of TS and ADHD may be similar or different.
- Different models (Rothenberger & Heinrich, 2022, Biomedicines):
  - Additive effects?
  - Interactive effects?
  - Different phenotype?

INTRODUCTION

- One way of tackling this question is through the study of functional connectivity.
  - Functional connectivity relates to how different brain regions are co-activated
  - This may inform on neural communication may differ across different disorders or conditions.
- Previous work suggest mostly additive effects of TS and ADHD (Jurgiel et al., 2022, Biol Psychiatry CNNI)



Jurgiel et al., 2022, Biol Psychiatry CNNI

OBJECTIVES

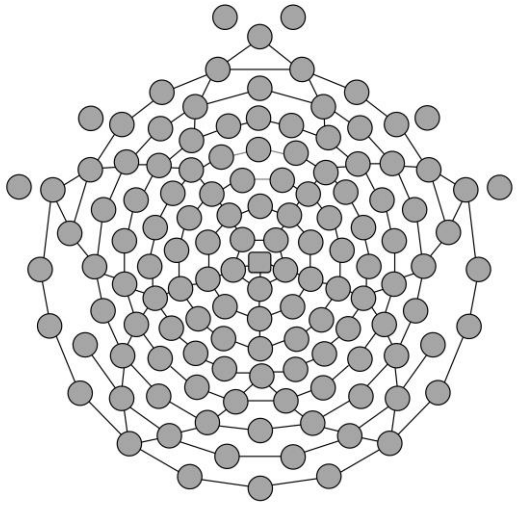
- Assess the separate and joint impacts of TS and ADHD on functional brain connectivity
  - Across several frequency bands

PARTICIPANTS

- 137 children
  - TS: 51
  - ADHD: 24
  - TS+ADHD: 29
  - Typically developing controls: 33
- Aged between 7 and 16 years old (mean = 11.1; SD = 1.9)

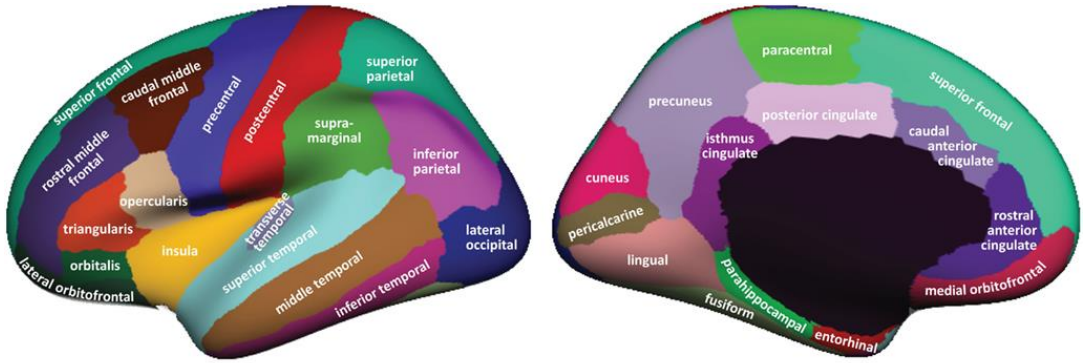
PROCEDURES

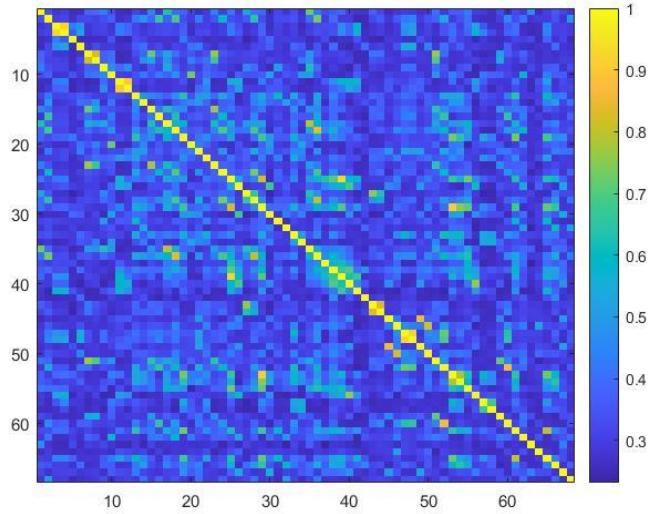
- High-density electroencephalography (hdEEG) recording during a 7-minute resting-state session.
- EEG preprocessing (filtering, artifact removal, interpotalation of bad channels, segmentation in 2-second epochs, re-referencing)



DATA PROCESSING

- Brain sources were reconstructed from sensor-level EEG data using weighted minimum norm estimation (wMNE) in Brainstorm software.
- Source activity projected onto the Desikan-Killiany atlas (68 cortical regions)
- Connectivity between these regions was computed with the phase locking value (PLV) in 5 frequency bands
  - Delta (1-4 Hz)
  - Theta (4-8Hz)
  - Alpha (8-13 Hz)
  - Beta (13-30 Hz)
  - Gamma (30-50 Hz)





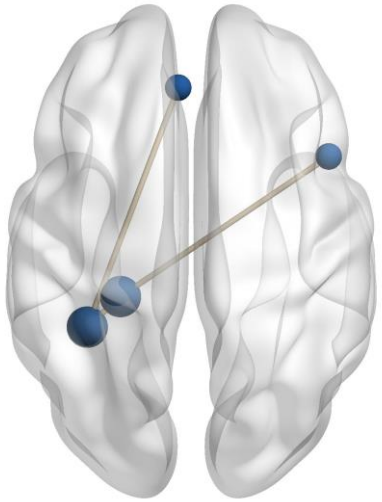
STATISTICAL ANALYSES

- Network-based statistics (NBS)
  - Allow the identification of functional connectivity subnetworks that differ between groups or that are associated with continuous measures.
  - While controlling for multiple comparisons (t-test performed for each connection) using permutation testing.
  - All analyses conducted with 2 (TS: present/not present) by 2 (ADHD: present/not present)

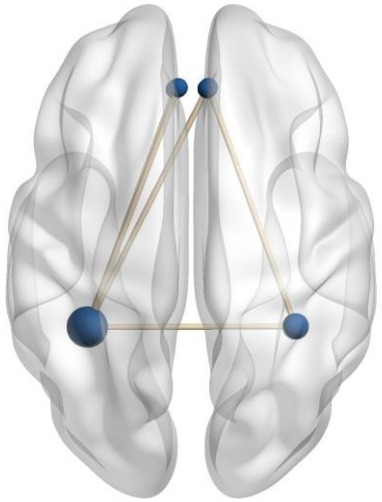
RESULTS

- ADHD main effect (delta: p = .042, theta: p = .018, alpha, p = .029)

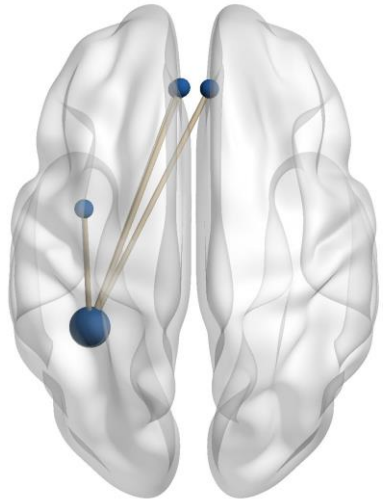
Delta



Theta



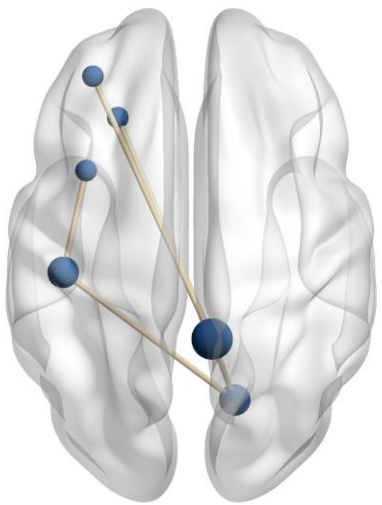
Alpha



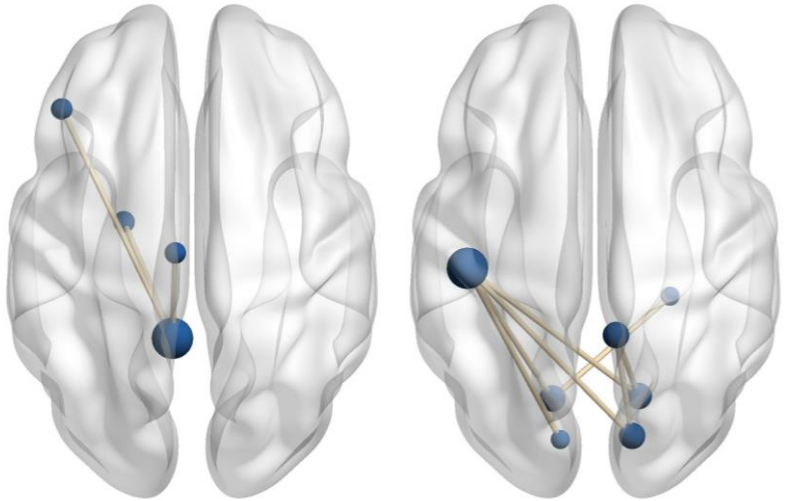
RESULTS

- TS main effect (delta: p = .019, theta: p = .009/p = .043, alpha: p = .030/p = .030)
- No significant ADHD*TS interaction

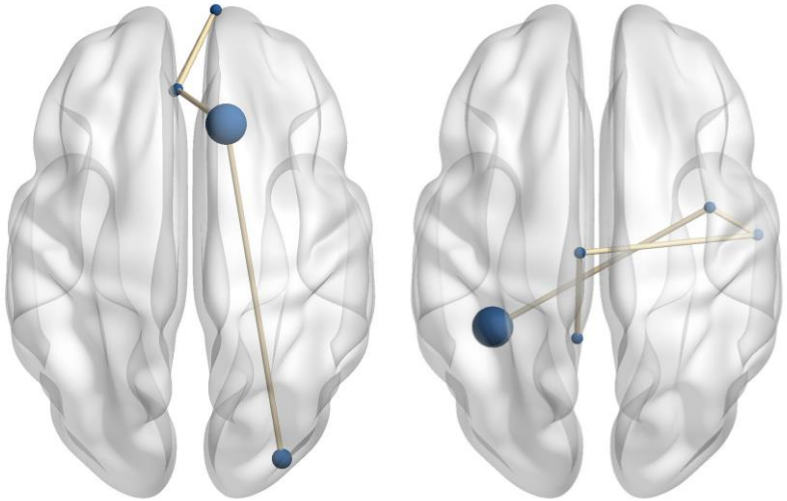
Delta



Theta



Alpha



DISCUSSION

- These results suggest that TS and ADHD are associated with different patterns of decreased connectivity in resting-state networks.
  - Additive but not interactive effects.
- It is possible that more complex cognitive demands may result in interactive effects.

ACKNOWLEDGEMENTS

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- Any questions?
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