

Blunted Brain Responses to Emotional Conflict Predict Anxiety in Adolescents with Epilepsy using Magnetoencephalography

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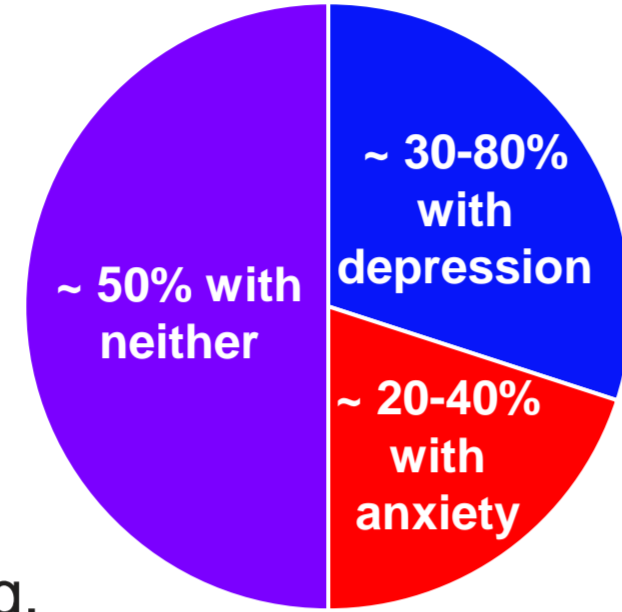
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RATIONALE

BACKGROUND

- Many people with **epilepsy** suffer from **depression** and **anxiety**, which often develops in **adolescence**.
- Deficits in **emotion regulation** are thought to underlie **depression** and **anxiety** and could be a potential mechanism for it as an **epilepsy comorbidity**.
- Though emotional conflict processing is well studied in depression using functional magnetic resonance imaging, its **spatiotemporal profile** has not been investigated in **epilepsy**.



GOAL

- Study the spatiotemporal profile of **emotional conflict** processing in adolescents with **epilepsy**, relative to controls using **magnetoencephalography (MEG)**

HYPOTHESES

- Adolescents with epilepsy will exhibit deficits in emotional conflict processing:
- Longer** response times and **lower** accuracy compared to controls
 - Relatively **lower brain** activity in amygdala, insula, cingulate & prefrontal cortices

METHODS

MEG/HD-EEG



Emotional Face-Word Stroop Task



Source Reconstruction and Analysis

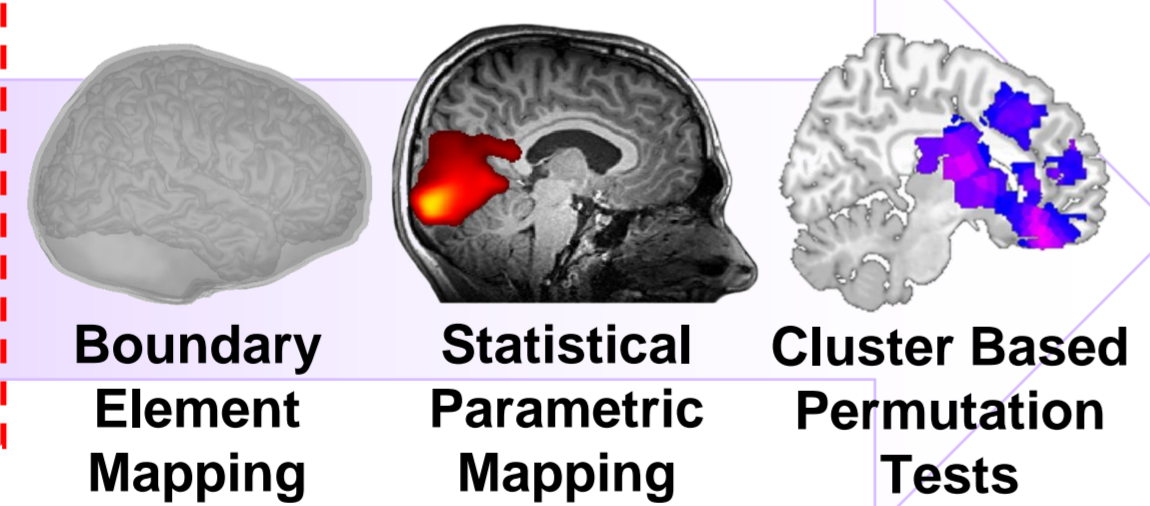


Figure 1. MEG Recording and Analysis Methods.

MEG RECORDING & PROCESSING

- 306-channel MEG recording (MEGIN, Finland)
- Pre-processed in Brainstorm (Tadel, 2019)

DATA ANALYSIS

- Behavior:** Response times & accuracy compared between groups using t-tests.
- MEG:** Source maps compared between groups using cluster-based permutation tests across ten 100 ms time windows post-stimulus. Regions of interest (ROIs) extracted from significant clusters based max T-values in AAL atlas regions for time-frequency analysis and clinical measure analyses.
- Clinical Measures:** Anxiety (GAD7) & depression (PHQ9) regressed with ROIs.

PARTICIPANTS

	Sample	Age	Male
Epilepsy	28 (14 Focal)	15.7	11
Control	25	13.5	15

BEHAVIORAL RESULTS

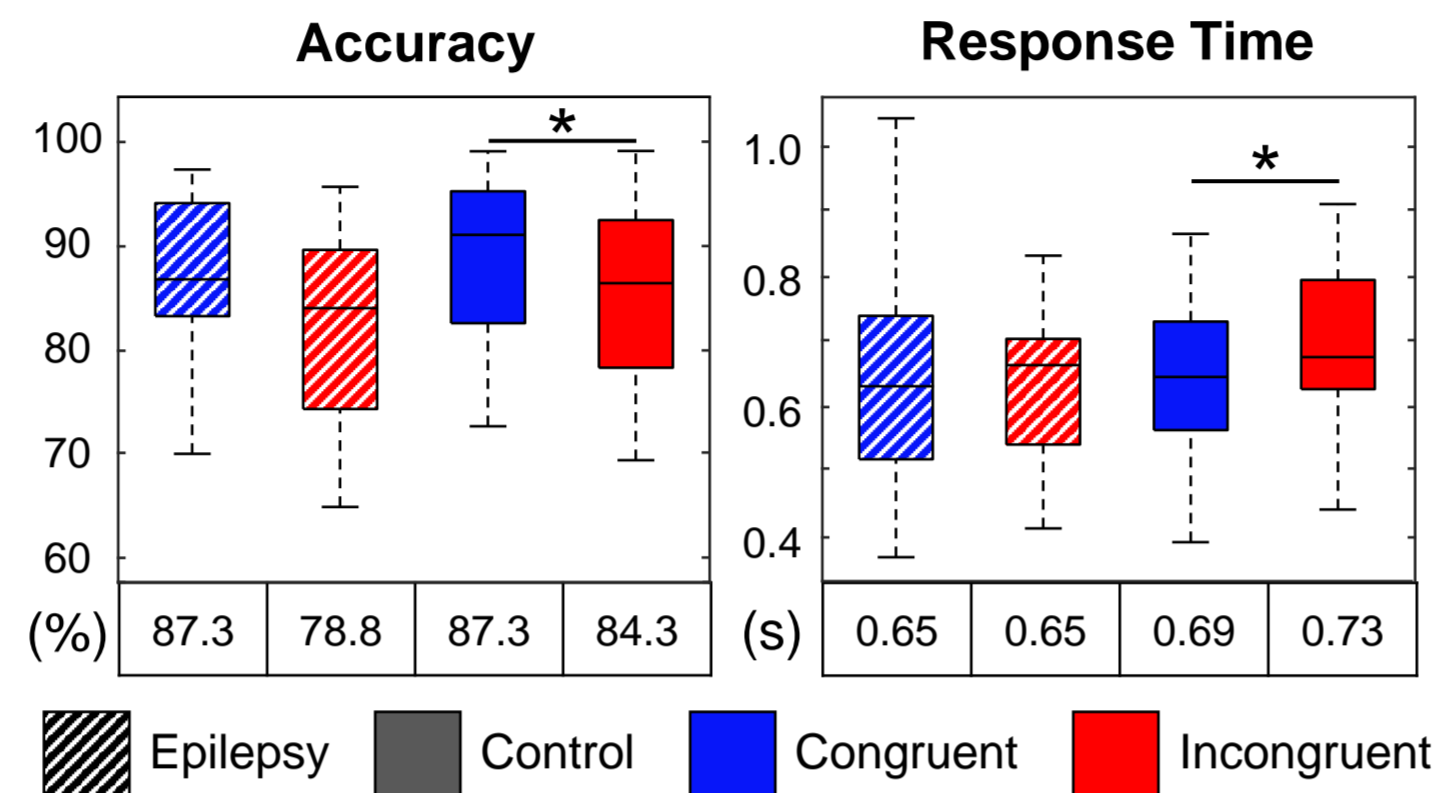


Figure 2. Response time and accuracy. Average accuracy (left) and response times (right) for adolescents with epilepsy and healthy controls, for incongruent and congruent trials. *indicates significant differences at $p < .05$

RESULTS

MEG EVOKED FIELDS

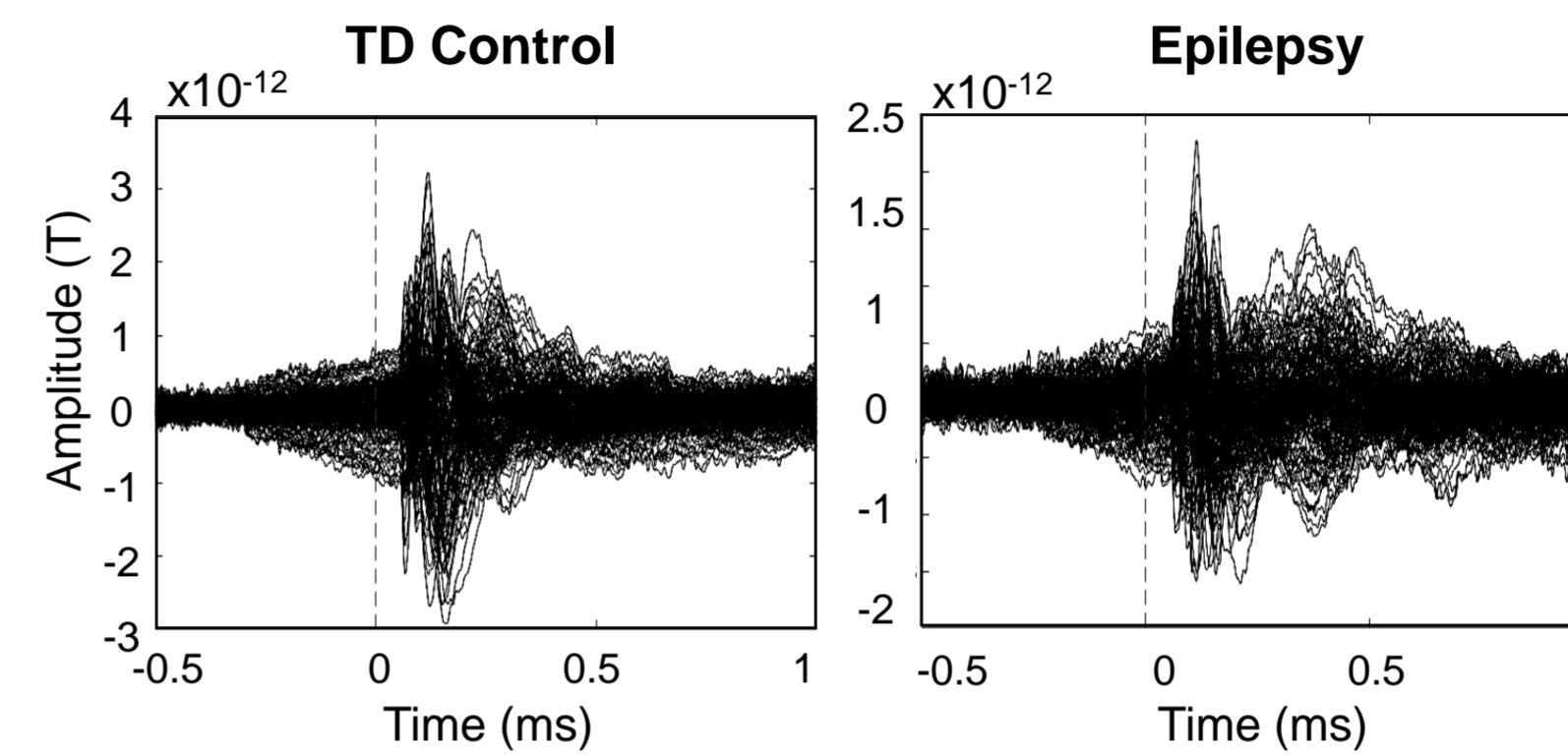


Figure 3. MEG Evoked Field Butterfly Plots. Grand average evoked responses across conditions of controls (left) and adolescents with epilepsy (right) from 306 MEG channels, including 204 gradiometers and 102 magnetometers.

BEHAVIORAL RESULTS

- While controls showed **typical behavior**, responding slower and less accurately to emotional conflict, adolescents with epilepsy **responded similarly** across conditions (Fig. 2).

MEG RESULTS

- Relative to controls, adolescents with epilepsy exhibited **blunted** brain activity in:
 - (500-600)** Left Postcentral & Middle cingulate
 - Predicted **anxiety** symptoms in those with **Focal Epilepsy**
 - (600-700)** Left Fusiform gyrus, Hippocampus & Precuneus
 - Predicted **anxiety & depression** symptoms in **Generalized Epilepsy**
 - (800-900)** Right Supracallosal Anterior cingulate cortex, Middle cingulate, & Orbitofrontal Gyrus
 - (900-1000)** Left Dorsolateral Prefrontal cortex, Supracallosal anterior cingulate & Pregenuar anterior cingulate cortex
 - Event-related desynchronization in the lower **Beta Band** at ~600-1000 ms

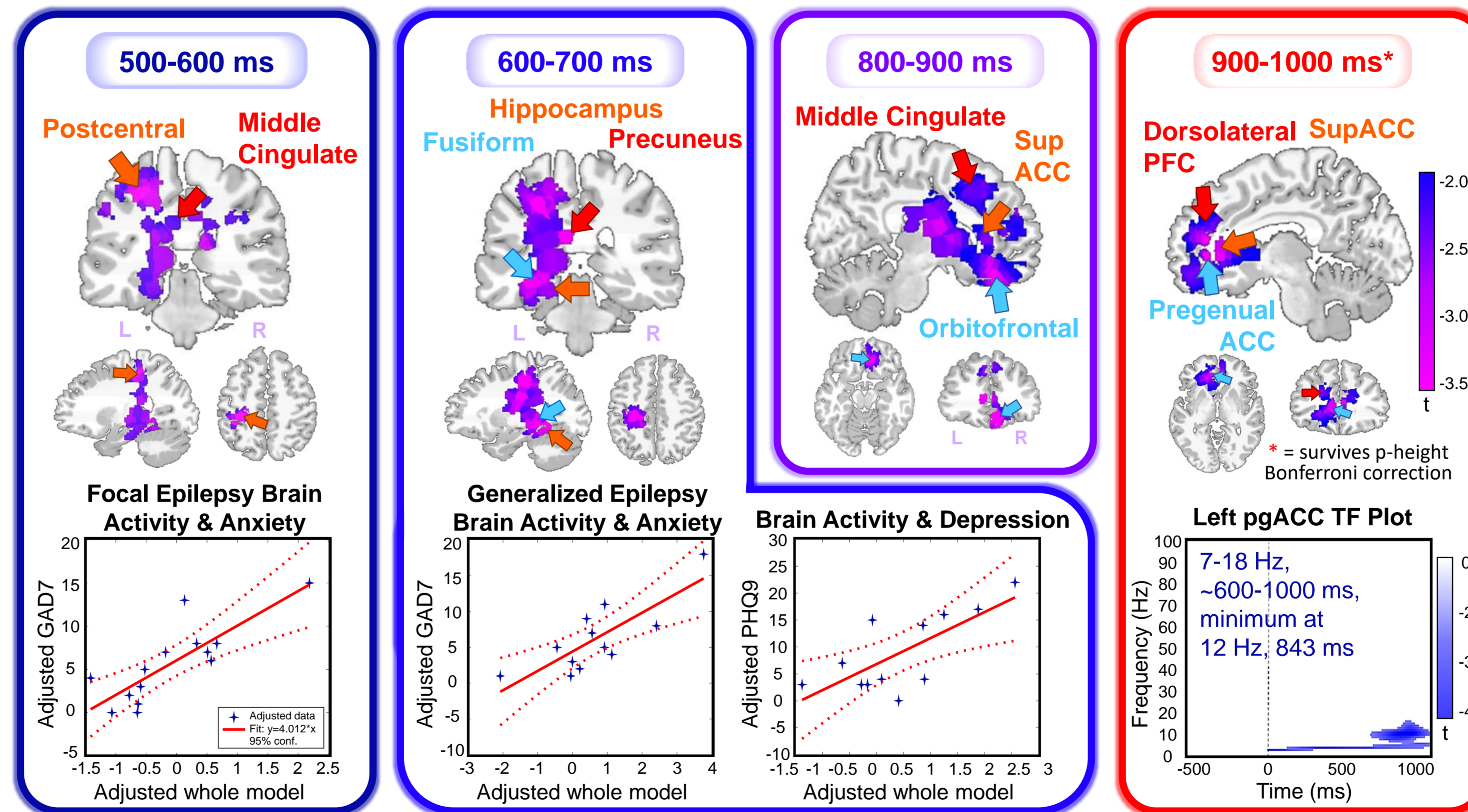


Figure 4. Cluster-based Permutation Test results. (From left to right) Relative to controls, adolescents with epilepsy exhibited blunted brain activity in: **(500-600)** Left Postcentral gyrus & Middle cingulate cortex ($p=.048$), which predicted anxiety symptoms in those with Focal Epilepsy; **(600-700)** Left Fusiform, Hippocampus & Precuneus ($p=.018$), which predicted anxiety ($p=.033$) and depression ($p=.010$) symptoms in those with Generalized Epilepsy; **(800-900)** Right Supracallosal Anterior cingulate (supACC), Middle cingulate, & Orbitofrontal Gyrus ($p=.022$); **(900-1000)** Left Dorsolateral Prefrontal cortex (dlPFC), Supracallosal & Pregenuar anterior cingulate (pgACC; $p=.032$), with the pgACC ROI showing event-related desynchronization in the lower Beta Band around 600-1000 ms ($p=.039$, $t=-4.30$).

CONCLUSION

DISCUSSION

- Adolescents with epilepsy** exhibit **blunted** brain responses to emotional conflict which are similar to those seen in **depression** and **anxiety** patients.
- These findings reveal a **shared dysfunction** between epilepsy and its psychiatric comorbidities, which could be a target for epilepsy treatment.

FUTURE DIRECTIONS

- Future treatments** that target these **shared dysfunctions** could reduce treatment time and **improve outcomes** by treating epilepsy and its **comorbidities** simultaneously.

QR CODE

