

## Introduction

- A promising neural marker associated with impaired face processing for individuals with autism spectrum disorder (ASD) is the N170 event-related potential (ERP). Individuals with ASD exhibit longer N170 latencies to faces compared to typically developing (TD) individuals (McPartland *et al.*, 2004).
- In addition to face processing, cortical excitation/inhibition (E/I) imbalances contribute to behavioral symptoms in ASD (Masuda *et al.*, 2019).
- Electroencephalographic (EEG) studies of E/I imbalance reveal
  - Increased spontaneous gamma oscillations (30-50 Hz) at rest in ASD (Cornew *et al.*, 2012; Orekhova *et al.*, 2007)
  - Attenuation of P100 amplitude in visual evoked potential (VEP) tasks (Siper *et al.*, 2016).
- Very few EEG studies have examined the relationship between E/I imbalance and neural indices of face processing in children with ASD.

### Central Questions

Is temporal processing of upright faces delayed in individuals with ASD?  
Do neural indices of E/I imbalance associate with abnormal face processing?

## Behavioral Methods

Cognitive assessments were conducted, and final diagnosis was determined by licensed clinical psychologists.

### Standard Psychometric Measures of Social and Cognitive Functioning

- Autism Diagnostic Observation Schedule, 2<sup>nd</sup> Edition (ADOS-II)
- Differential Ability Scales, 2<sup>nd</sup> Edition (DAS-II)
- A Developmental Neuropsychological Assessment (NEPSY-II)

### Exclusion Criteria

- Children with sensory or motor impairments, epilepsy, and genetic or neurological conditions

### Participant Demographics

Clinical Diagnosis	N	Sex (M,F)	Age (SD)	IQ (SD)	NEPSY-II: Affect Recognition Scaled Score (SD)
TD	54	35, 19	8.53 (1.74)	116.30 (13.44)	11 (4)
ASD	106	85, 21	8.94 (1.60)	101.14 (17.53)	8 (4)

**Figure 1. Clinical Criteria.** Groups were matched on age ( $p>0.05$ ) but differed significantly on Full-scale IQ and NEPSY-II Affect Recognition scaled scores ( $p<0.01$ ).

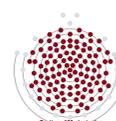
## EEG Methods

**Acquisition:** EEG was recorded at 1000 Hz with a 128-channel HydroCel Geodesic Sensor Net

### Experimental Paradigm: Resting State

*Objective: Assess brain activity at rest (eye open) how activity relates to abnormalities of cortical E/I imbalance*

- Design:** 6 x 30 sec videos of non-social dynamic abstract images
- Inclusion criteria:** > 20 seconds of attended and artifact free EEG segments
- Primary dependent variable:** Slope of the power spectrum
  - Gamma ( $\gamma$ ; 30-50 Hz)



**Figure 2.** Montage for spectral analysis.



**Figure 3.** Abstract stimuli used for resting state recording.

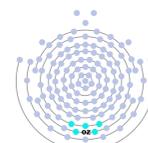
### Experimental Paradigm: VEP

*Objective: Explore possible consequences of an E/I imbalance on the visual system in ASD*

- Design:** Black and white checkerboards reverse phase every 500ms for a total of 100 trials
- Inclusion criteria:** > 20 artifact-free trials
- Primary dependent variable:** P1 peak amplitude



**Figure 4.** Stimuli used for VEP paradigm.



**Figure 5.** Montage for spectral analysis.

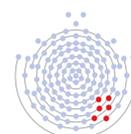
### Experimental Paradigm: ABC-CT Faces

*Objective: Examine neural processing of faces*

- Design:** 216 total trials of static images of upright faces, inverted faces, and houses
- Inclusion criteria:**  $\geq$  20 artifact-free trials
- Primary dependent variable:** N170 latency for upright faces



**Figure 6.** Stimuli used for ABC-CT Faces.



**Figure 7.** Selection of electrodes for N170 analysis.

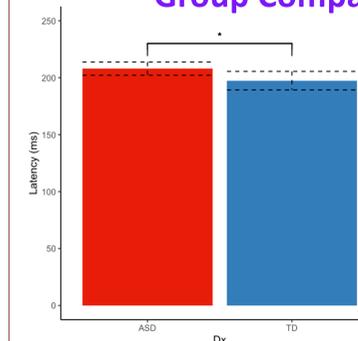
## Acknowledgments

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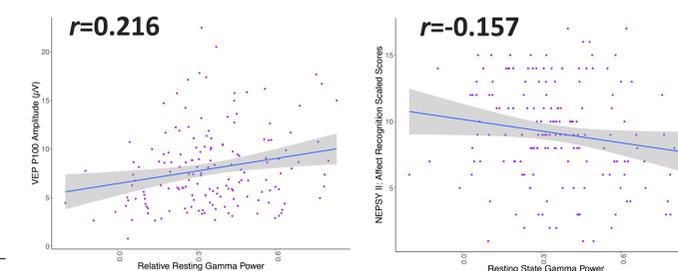
## Results

### Group Comparison



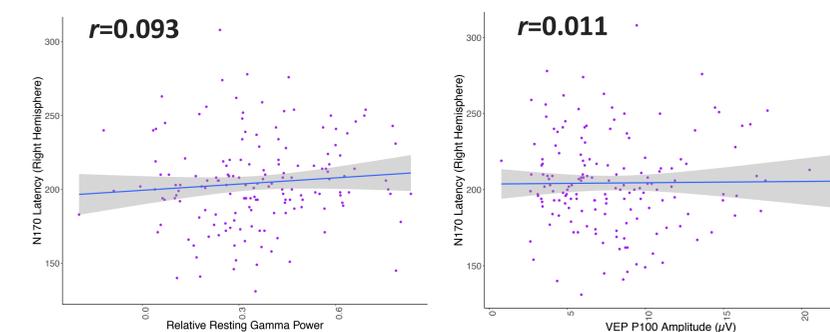
**Figure 8.** Slower N170 latency for upright faces in individuals with ASD [ASD:  $207.96 \pm 15.08$  ms; TD:  $197.41 \pm 14.89$  ms,  $p=0.037$ ].

### Correlation Analysis



**Figure 9.** Resting-state gamma power was correlated with VEP P100 amplitude ( $r(160)=.216$ ,  $p=0.006$ ) and negatively correlated with NEPSY-II: Affect Recognition Scaled Score ( $r(160) = -.157$ ,  $p=0.048$ ).

### Neural Indices of E/I Mechanisms vs. N170



**Figure 10.** Resting-state gamma and VEP P100 amplitude was not associated with different N170 latencies for upright faces ( $p>0.05$ ).

## Conclusions

- Confirming previous research, individuals with ASD exhibited longer N170 latencies for upright faces compared to TD participants.
- Visually-evoked P100 amplitude was related to spontaneous gamma-power, suggesting that VEPs and gamma oscillations may be generated by similar neuronal pools.
- Additionally, spontaneous gamma power was found to predict a behavioral measure of facial recognition.
- Contrary to our hypothesis, there was an absence of relationship between E/I measures and the N170.

## References

- Cornew *et al.* (2012). Resting-state oscillatory activity in autism spectrum disorders. *J. Autism Dev. Disord.* 42, 1884-1894.
- Masuda *et al.* (2019). Motor cortex excitability and inhibitory imbalance in autism spectrum disorder assessed with the transcranial magnetic stimulation: a systematic review. *Translational Psychiatry*, 9, 110.
- McPartland *et al.* (2004). Event-related brain potentials reveal anomalies in temporal processing of faces in autism spectrum disorder. *Journal of Child Psychological Psychiatry*, 45, 7, 1235-45.
- Orekhova, *et al.* (2007). Excess of high frequency electroencephalogram oscillations in boys with autism. *Biol. Psychiatry* 62, 1022-1029.
- Siper *et al.* (2016). Rapid and Objective Assessment of Neural Function in Autism Spectrum Disorder Using Transient Visual Evoked Potentials. *PLoS One*, 11.