ALPHA POWER IN ASD

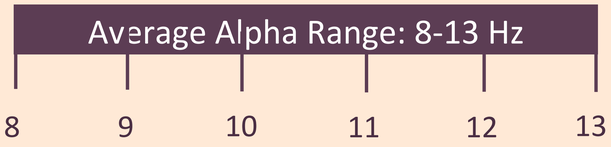
Katherine Wadhwani, Caitlin Hudac, Trent DesChamps, Brianna Cairney, Monique Mahony, Anne Arnett, Daisy Ma, Mark Pettet, Sara Jane Webb, and Raphael Bernier

INTRO

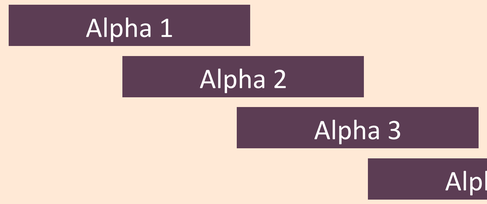
- Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by clinically recognized deficits in social communication, repetitive behaviors, and restricted interests. Biological indicators of the disorder are essential in pinpointing the neural activity that gives rise to the disorder's hallmarks. Resting state electroencephalography (EEG) studies suggest altered default signaling associated with ASD (Lefebvre 2018), with particular deviations in the power of the alpha frequency band (8-13 Hz) thought to reflect social and cognitive impairments. Previous work has produced contradictory findings (Lefebvre 2018), though many studies have found reduced alpha power (Murias 2017, Tierney 2012).
- **Objective:** We sought to determine whether alpha power among individuals with ASD, as compared to neurotypical individuals, was consistent across different methods of measurement, specifically average power and peak power.
- **Hypothesis:** We predict group differences when measuring alpha by average power but not when measuring by peak power.

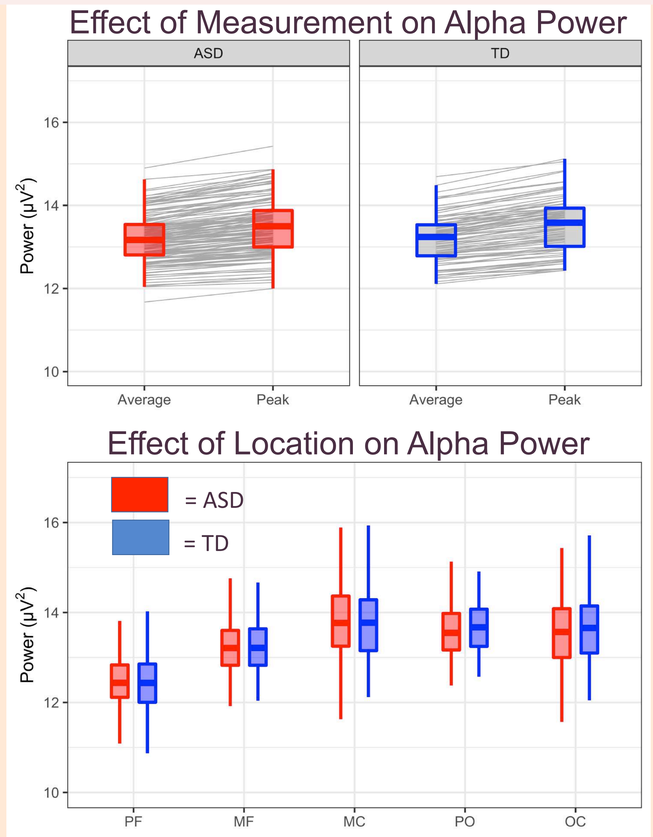
METHODS

- 219 participants completed this study and were recruited from previous studies or via advertisements.
- EEG data was collected via Electrical Geodesic Inc. (EGI) high-density sensor nets during an eyes-open resting task in which participants viewed slow moving shapes of various colors. The experiment included three 1-minute resting segments.
- Basic EEG processing included filtering (0.3-40 Hz, 1 s segmentation, artifact correction, and average referencing.
- Fast Fourier transformation (FFT) was used to compute power values

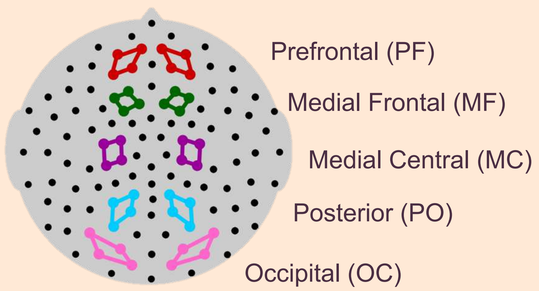


Peak alpha selected as the highest power value from moving window average calculated across 4 bands.





Electrode Placement



Participants	ASD	TD
N	138	81
Male/Female	102/36	47/34
Mean Age Years (SD)	12.3 (6.7)	10.6 (4.1)
Mean Verbal IQ (SD)	82.5 (30.8)	115.5 (13.7)
Mean Nonverbal IQ (SD)	82.7 (29.6)	115.9 (14.6)

Alpha Power Values	ASD	TD
Alpha Average (SD)	13.20 (0.81)	13.19 (8.2)
Alpha Peak Range		
8-10 Hz	73.8%	75.8%
9-11HZ	17.1%	15.8%
10-12 Hz	5.6%	6.9%
11-13 Hz	3.5%	2.1%

RESULTS

Mixed Multi-Level Models using full factorial design conducted using SAS 9.4.

- Pairwise comparisons explained the significant Group x Measurement interaction. Measuring by peak power produced higher values than measuring by average power in both ASD, $t(4183) = 24.92$, $p < .0001$, as well as TD, $t(4183) = 21.78$, $p < .0001$.
- There were no significant group differences in either peak alpha, $t(223) = 0.13$, $p = .90$, or average alpha, $t(223) = 0.38$, $p = .70$.
- The extent of the measurement effect (peak > average) was larger for TD relative to ASD, $t(4183) = 2.15$, $p = .013$.

Type 3 Tests of Fixed Effects	Statistic	P-value
Main effects		
Group (TD, ASD)	F(1, 217) = 0.02	0.90
Measure (Average, Peak)	F(1,4183) = 1052.47	<.0001
Region (PF, MF, MC, PO, OC)	F(4,4183) = 2088.44	<.0001
Hemisphere (Right, Left)	F(1,4183) = 127.22	<.0001
2-way interactions		
Group x Measure	F(1,4183) = 4.64	0.03
Group x Region	F(4,4183) = 9.36	<.0001
Measure x Region	F(4, 4183) = 2.10	0.08
Measure x Hemisphere	F(1,4183) = 0.29	0.59
Region x Hemisphere	F(4, 4183) = 79.19	<.0001
3 -way interactions		
Group x Measure x Region	F(4, 4183) = 0.06	0.99
Group x Region x Hemisphere	F(4, 4183) = 1.05	0.38
Measure x Region x Hemisphere	F(4,4183) = 0.38	0.82
4-way interaction		
Group x Measure x Region x Hemisphere	F(4, 4183) = 0.03	1.00

CONCLUSIONS

Measuring alpha by average power and peak power produced similar results in ASD and TD groups.

Peak alpha was greater than averaging across the full alpha spectrum (8-13 Hz).

Future directions

- Standardize alpha range
- Sample differences (IQ, gender, etc.)
- Need for more sophisticated models to study alpha during social context (Lefebvre 2018).