Interactive Social Neuroscience to Assess EEG Resting State Activity in the Broad Autism Phenotype

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Background

- Autism Spectrum Disorder (ASD) is hallmarked by interpersonal difficulties, yet there is limited research examining brain activity during actual social interaction
- The "default network", or the system of brain regions active when one is not performing an explicit task, overlaps with social brain systems (Schilbach, 2008)
- Verbeke et al. (2014) previously found differences in electroencephalography (EEG) resting state activity in alpha, beta, and theta when participants were resting together versus resting alone
- This study utilized interactive social neuroscience methods to examine oscillatory activity measured with EEG in a social context and associations with autistic traits in typically developing (TD) adults
- **Objectives:** Characterize neural markers of resting brain activity during an interpersonal interaction and their association with autistic traits in a social context

Method

Participants:

- 16 TD adults (6 male), grouped in same-sex dyads, recruited from the Yale University community
  - Mean Age=21.7 years (SD=0.5)
- Participants completed the Autism Quotient (AQ) to assess social function and dysfunction
  - Mean Total AQ Score=14.0 (SD=4.9)

Resting Paradigm:

- Dyads sat quietly for two minutes with their eyes closed (EC) and eyes open (EO) while in (1) "separate" rooms, (2) the same room with their "backs" to each other, (3) the same room while "facing" each other

EEG Data Acquisition and Collection:

- Recorded at 256 Hz using Advanced Brain Monitoring X-24 EEG sensor net
- 20 electrodes placed according to international 10-20 system with mastoid reference

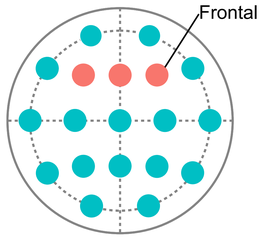

Figure 1: Electrodes were placed according to the international 10-20 standard. EEG data were extracted from frontal electrodes (F3, Fz, F4).

EEG Analysis:

- EEG data pre-processed using PREP Pipeline to remove line noise, re-reference, and detect and interpolate bad channels
- Independent component analysis performed and eye-blink components identified and removed
- Data filtered from 0.5 Hz to 100 Hz and epoched into 1000 ms segments
- Epochs containing artifacts were rejected
- FieldTrip Toolbox was used to calculate power per trial using a multitaper method
- Theta 4-7 Hz, Alpha 8-12 Hz, and Beta 12-24 Hz based on Verbeke et al. (2014)

Statistical Analysis:

- EEG power analyzed using repeated measures ANOVA
- Within-subjects factors:
  - Condition (separate/back/facing) x Eyes (open/closed; EO/EC)
- Differences between conditions correlated with behavioral measures

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Preliminary Results

Theta (4-7 Hz)

- Theta activity was greater during EO than EC, $F(1,12)=6.6$, $p=0.03$
- There was a main effect of Condition, $F(2,24)=4.2$, $p=0.03$
  - Theta activity was greater during SEP than BACK, $p=0.01$, and FACE, $p=0.04$

Alpha (8-12 Hz)

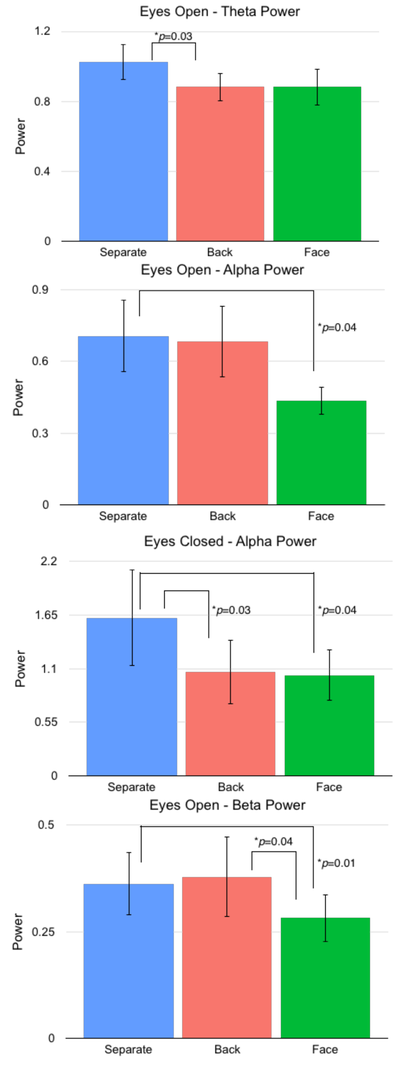
- Alpha activity was greater during EC than EO, $F(1,12)=5.3$, $p=0.04$
- There was a main effect of Condition, $F(2,24)=5.7$, $p=0.01$
  - Alpha activity was greater during SEP than BACK, $p=0.03$, and FACE, $p=0.02$

Beta (12-24 Hz)

- Beta activity was greater during EC than EO, $F(1,12)=6.1$, $p=0.03$

Figure 2: Plots show log-transformed spectral activity during rest with eyes open and eyes closed in BACK, FACE, and SEP conditions.

Figure 3: Spectral activity when resting. Columns indicate spectral power in each condition.



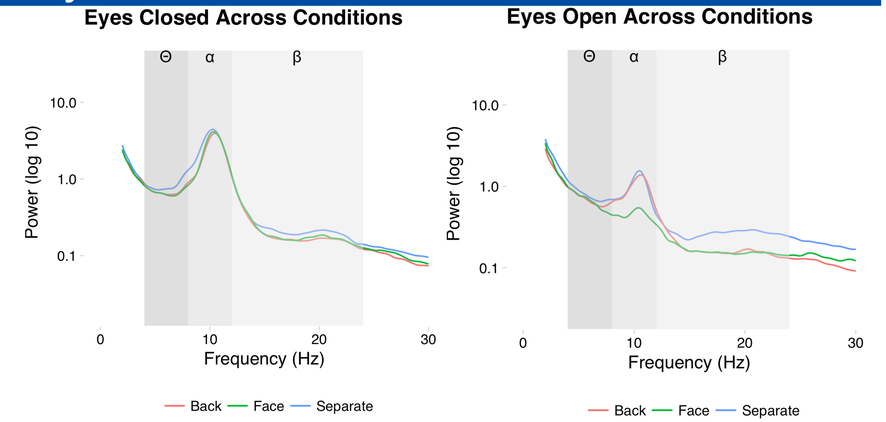
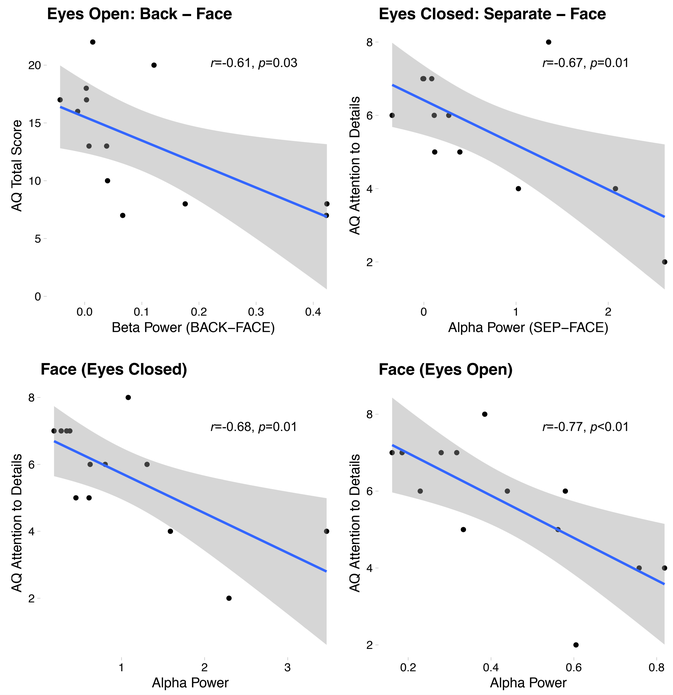


Figure 4: Log transformed spectral activity when resting with eyes closed and eyes open when separate, back, and facing.

Figure 5: AQ total and subscale scores correlated with spectral activity.



Conclusions

- In this interactive social neuroscience experiment, the presence of another person modulated resting brain activity
- Individuals with lower levels of autistic traits exhibited greater alpha power when resting separately compared to when resting with another person
  - This suggests greater sensitivity to the presence of another person
- Our findings provide new insight into modulation of resting state brain activity through the presence of another person and emphasize the importance of utilizing more naturalistic and ecologically-valid approaches in neuroscientific studies of social brain function