

Background

- Autism Spectrum Disorder (ASD) is a collection of neurodevelopmental disorders characterized by social, behavioral and communication impairments (CDC, 2014).
- Sex differences in ASD effect diagnosis, symptom severity, and overall presentation of the disorder (Mandy et al. 2012).
- Frontal alpha asymmetry (FAS) refers to differences in resting anterior cortical activity measure by EEG (electroencephalogram). These differences may be related to individual variability in social symptoms and social development among children with ASD (Sutton et al., 2005).
- Evidence has been observed that boys with ASD who displayed right FAS had greater social impairments (Sutton et al., 2005).
- Currently the relationship between FAS and social impairments in girls with ASD is unknown.

Research Questions

- Are FAS and ADOS/SRS scores correlated? Are there sex differences in those relationships?
- Are there sex differences in frontal asymmetry?
- Are there sex differences in ADOS or SRS scores?

Methods

Participants

137 children between the ages of 8 and 17 were taken from the GENDAAR study for these analyses. All children had a confirmed diagnosis of ASD, IQ> 70.

Group	Age	IQ Nonverbal	ADOS Scores	SRS Total Scores
Males	N=78, M=12.19yrs	N=78, M=100.83, SD=18.08	N=78, M=7.17, SD=1.79	N=76, M=90.04, SD=27.25
Females	N=59, M=12.45yrs	N=59, M=100.12, SD=17.86	N=59, M=6.63, SD=1.79	N=57, M=94.44, SD=27.42
Total Group	N=137, M=12.25yrs	N=137, M=100.53, SD=17.925	N=137, M=6.93, SD=1.808	N=133, M=92.07, SD=27.324

Measures

- Autism Diagnostic Observation Schedule, Calculated Severity Score (ADOS) – Participants were engaged in a semi-structured assessment of communication, social interaction, and play (or imaginative use of materials) with a clinician to determine ADOS scores. The ADOS systematic and standardized method for identifying kids with ASD.
- Social Responsiveness Scale (SRS) – Parents of participants completed the Social Responsiveness Scale (SRS), a 65-item questionnaire assessing social behaviors, which provides scores for social motivation, social cognition, and social awareness

Resting State EEG Data Collection

High density EEG (Electrical Geodesics, Inc.) was collected while participants viewed three or four sets of four 16-second videos to collect eyes open resting data. EEG was filtered from .1 – 100 Hz segmented into 2048 ms segments, movement and blink artifacts were rejected and data were re-referenced to an average reference. Subjects were included if they provided 20 clean segments for a condition. Only eyes open data was used to compute frontal alpha asymmetry.

Methods Cont.

EEG Data Processing

- Fast Fourier Transforms (FFTs) were performed over clean segments, and absolute power was calculated for the Alpha band (8-12hz) across the frontal region of the scalp.
- Frontal Asymmetry Scores (FAS) were calculated using a log transformation: $Frontal\ Asymmetry\ Index = \log\left(\frac{power_{left} - power_{right}}{power_{left} + power_{right}}\right)$
- More negative values reflect more left asymmetry, more positive values reflect more right asymmetry



Figure 1 Example of participant in EEG net

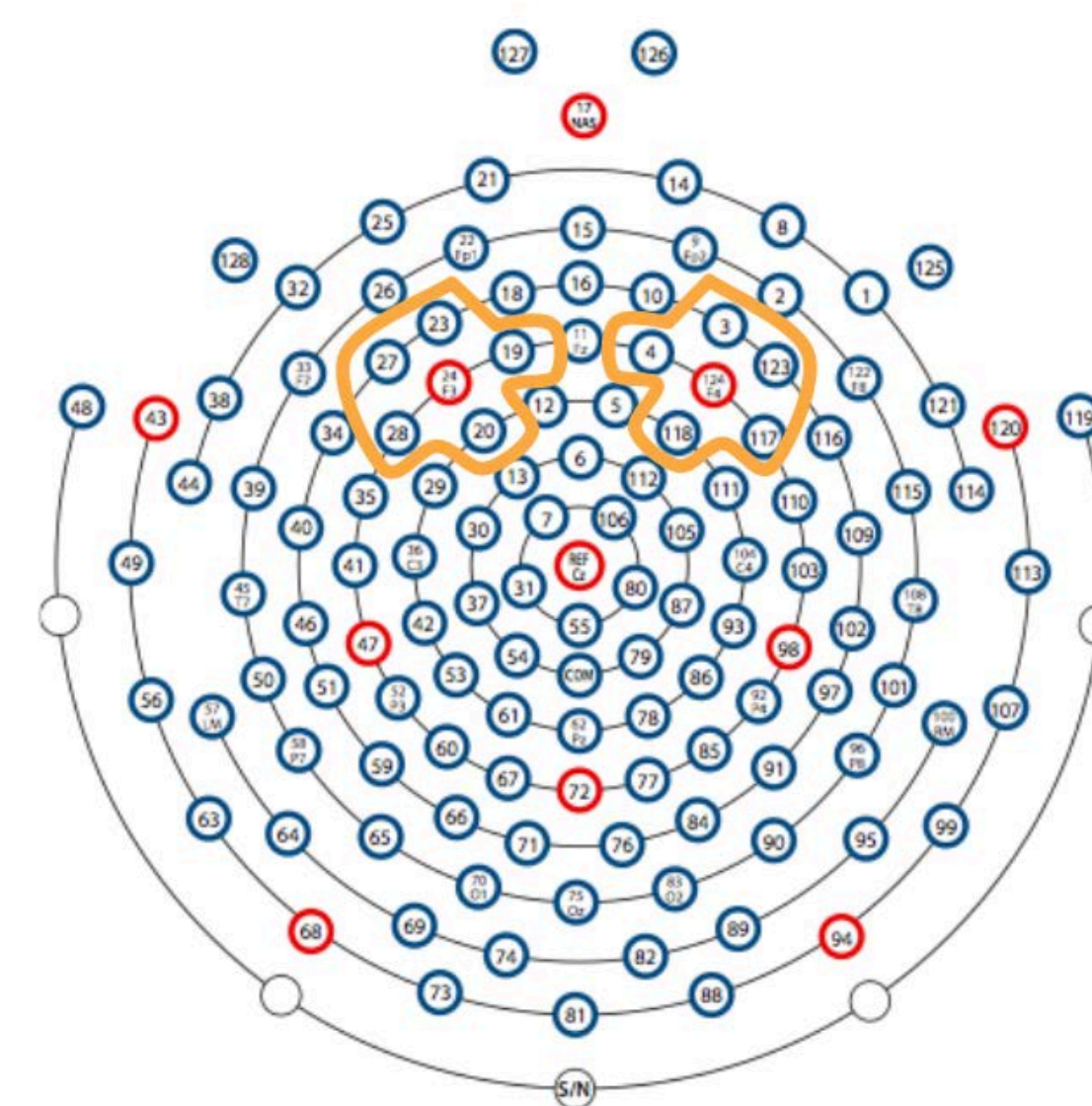


Figure 2 EEG Net with specific electrodes used for FAS

Results

Are FAS and ADOS/SRS scores correlated? Are there sex differences in those relationships?

- A Pearson R correlation was run between ADOS CSS scores and FAS. there was a positive correlation, where greater autism severity was associated with greater right asymmetry, $r=.192$ $N=137$, $p<.05$.
- A Pearson R correlation was run between SRS subscales (social motivation, social cognition, and social awareness) and FAS. No relationship was found to be significant $p>.05$
- The above correlations were run separately for males and females, no correlations reached significance ($p>.05$)

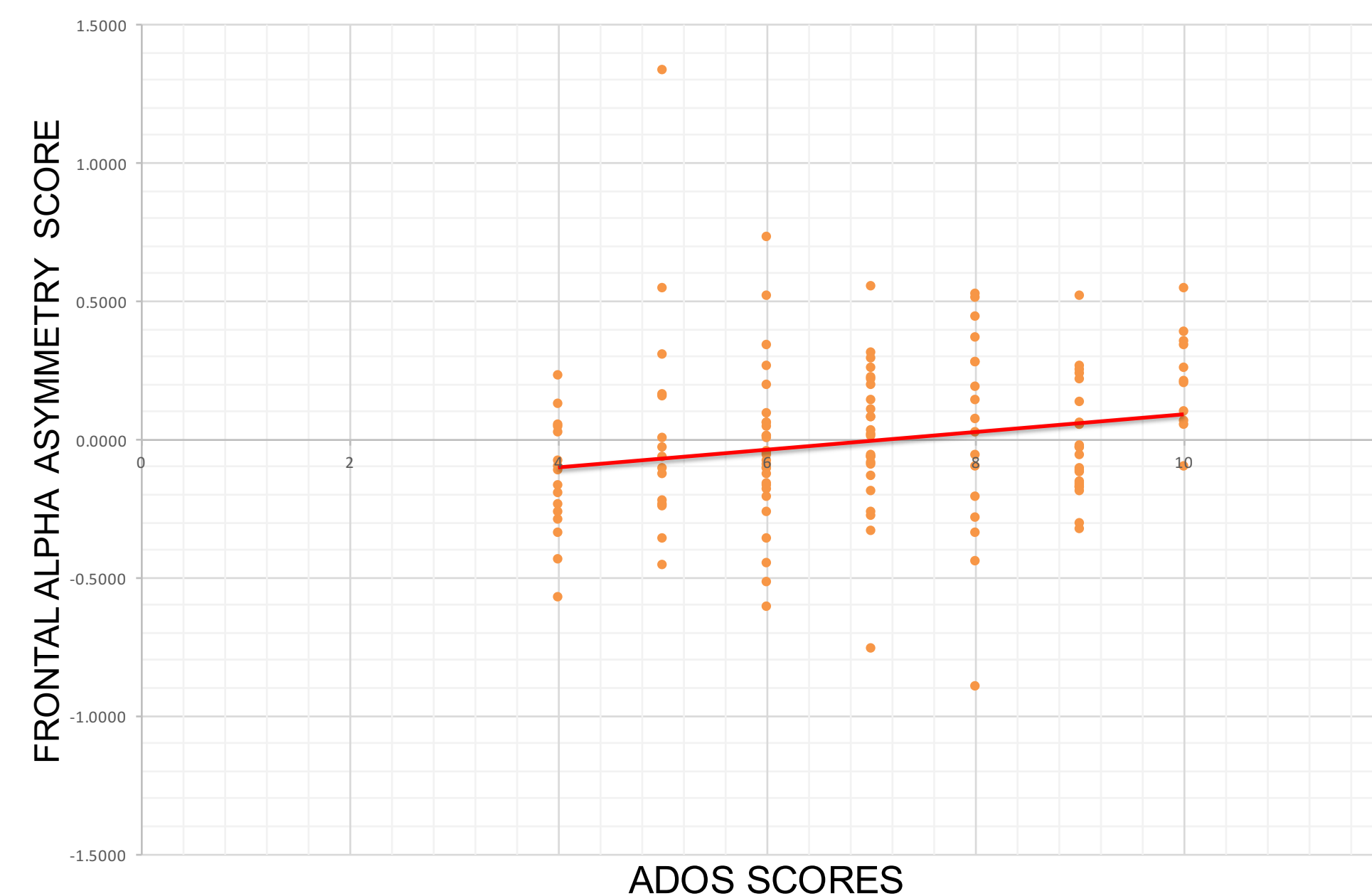


Figure 3 Correlation scatter plot of the relationship between ADOS CSS Scores and FAS Scores.

Results

Are there sex differences in FAS?

Males and females did not differ in FAS $M=.006$, $SD=.261$ $p=.576$ (two-tailed).

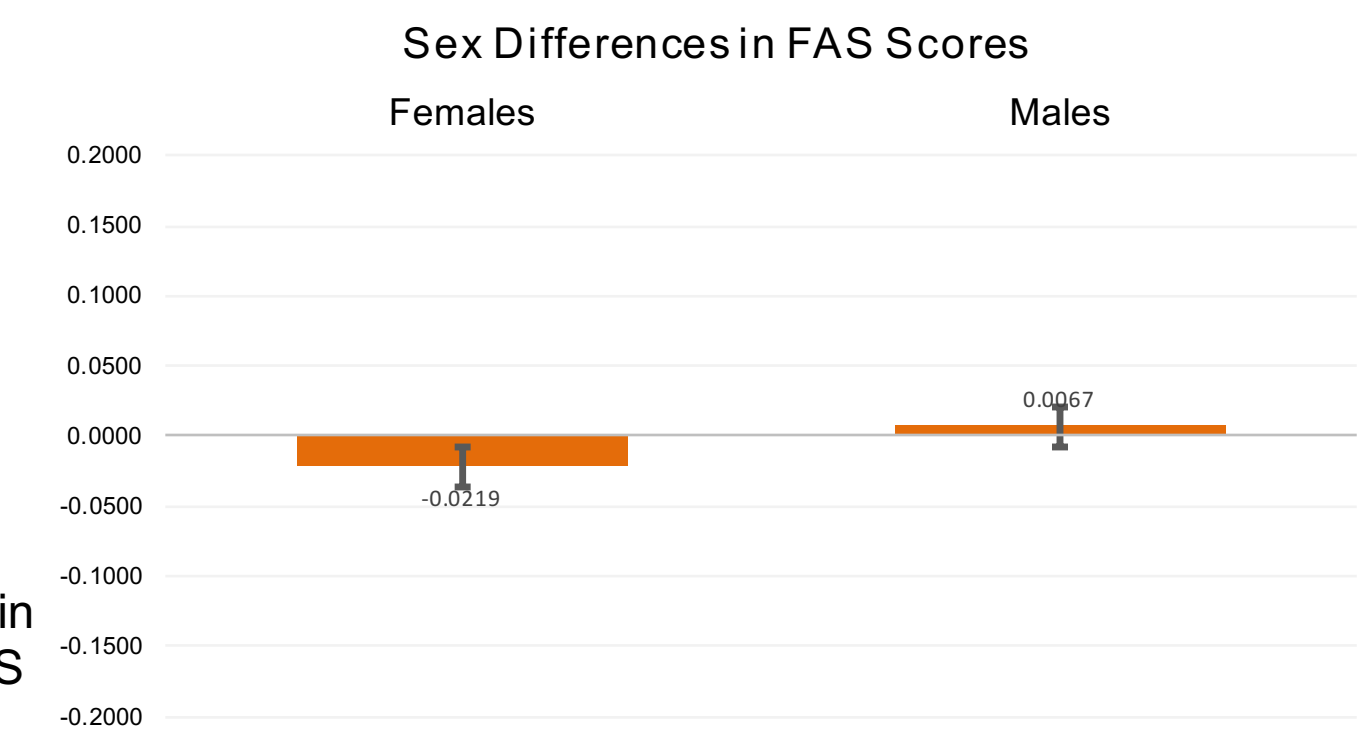


Figure 4 Graph showing differences in means between male and female FAS scores

Are there sex differences in ADOS or SRS scores?

There were marginal sex differences for ADOS CSS scores between males and females ($M=6.63$, $SD=1.79$, $t(1.742)=$, $p=.084$ (two-tailed). No significant sex differences were found for SRS scores $P>.05$.

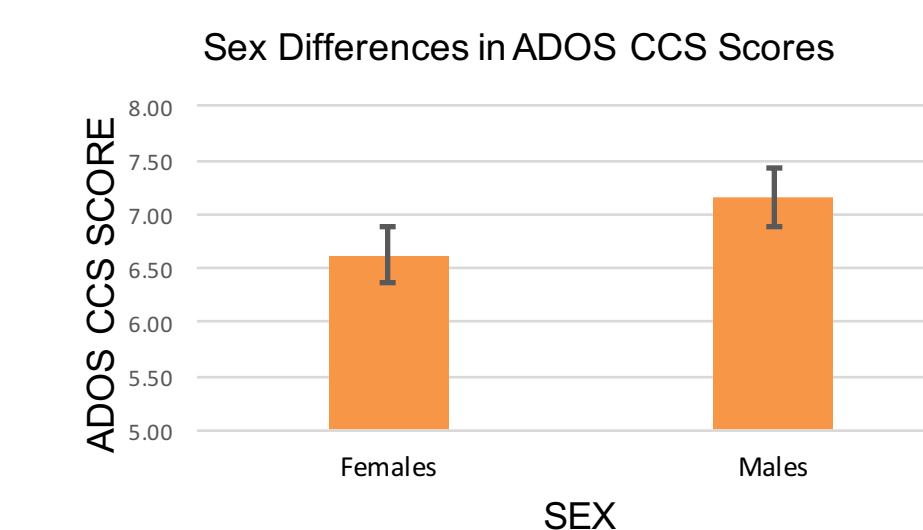


Figure 5 Graph showing differences in means between male and female ADOS CCS Scores

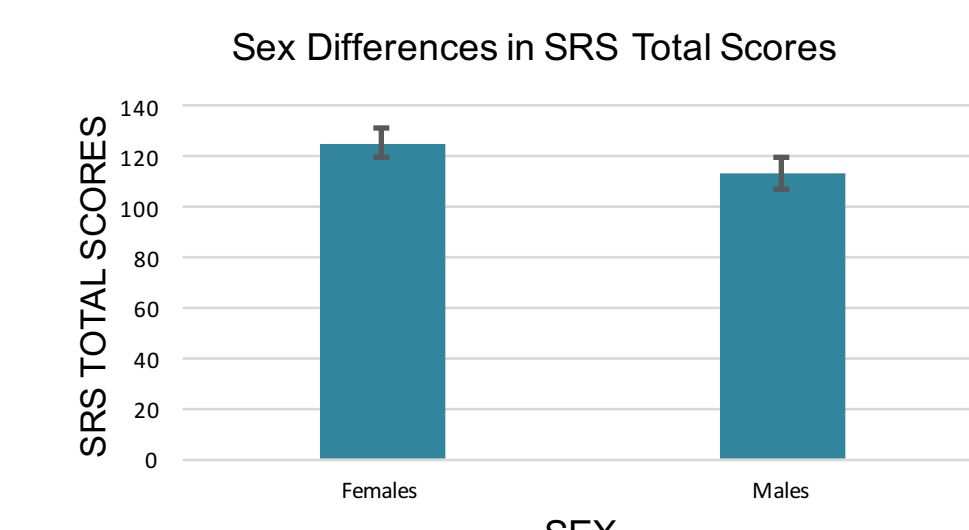


Figure 6 Graph showing means between male and female SRS total scores

Discussion

Summary

- ADOS scores were correlated with FAS. The positive correlation indicates that greater right asymmetry is associated with greater overall autism impairment.
- FAS was not significantly correlated with any of the SRS subscales or total SRS scores.
- Exploratory analysis found ADOS CCS scores differed marginally by sex, while SRS total and subscale scores did not.

Conclusions

- Our findings suggested that greater right activation was associated with greater overall ASD impairment. This supports existing evidence that greater right frontal activation leads to greater avoidant behaviors in ASD (Burnette et al. 2010).
- While the association was only significant with ADOS and not SRS scores this could be due to the fact that the ADOS is a more direct observation of child's ASD behaviors, while the SRS is a parent-report questionnaire about broad behavior patterns. Further, FAS may be only related to some types of social impairments that were not reflected in the measures we used here..
- There is little data for EEG patterns of females with ASD. Our study was comprised of a large group of females and an overall balanced subject pool. Because of this we were able to look at sex differences in a unique way. However, our findings did not support past results that FAS differs significantly in boys and girls. Further exploration is needed to clarify the role of sex in FAS.
- This project explored the role of sex differences in the relationship between FAS and social impairment. Our results provided some answers to this question but also open the stage for deeper exploration into how sex can effect the many facets of ASD in kids.

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