Sex Differences in the Neural Processing of Interactive Eye Contact in Individuals with Autism Spectrum Disorder

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Method

- Autism spectrum disorder (ASD) is characterized by difficulties in social interaction.
- Electroencephalography (EEG) techniques can be used to study social perception, with the P100 serving as an indicator of early visual processing and the N170 marking face-specific processing.
- Previous work from our group identified differences in neural processing of one type of dynamic social information, interactive eye contact, between individuals with ASD and typical development (TD).
- Sex differences in ASD exist in the processing of social information, including in neural response to static faces (Cooperman et al., 2015).
- The objective was to identify sex differences in neural processing of interactive eye contact in individuals with ASD and TD.

Participants

- Sex n Mean Age Mean IQ
  - Male 83 16.8 102
  - Female 83 16.8 100

EEG and ET Data Acquisition and Collection

- EEG was recorded at 100 Hz with a 19-channel Hydrogel Geodesic Sensor net.
- ET data was collected using an Eyelink-1000 remote camera system.

Event-related Potential (ERP) Analysis

- P100 (100-160ms) and N170 (150-300ms) were extracted from electrodes over left and right occipitotemporal regions (C3, C4, P3, P4, PO7, PO8, O1, O2, 65, and electrodes 96, 95, 91, 84, 80 respectively, see Fig. 2). Data were filtered at 0.1 to 30Hz and segmented to ±100 to 500ms relative to shift in stimulus gaze. Trials with eye movements greater than ±1 degrees or blinks were excluded.
- Peak amplitude and latency were analyzed for responses to direct and averted gaze face presentations using ANOVAs (with diagnostic group and sex as between-subject factors and gaze condition and hemisphere as within-subject factors).

Results

- There were no significant differences between males and females with ASD and TD (p>0.05) (Fig. 3A).
- A significant interaction was found between sex and condition (R1, 110)=4.17, p<0.05 and a significant interaction in the left hemisphere N170 compared to left hemisphere N170 compared to right hemisphere N170 (p<0.01), while left and right hemisphere N170s for females with ASD and males with TD did not differ significantly (Fig. 4). There was also a marginally higher amplitude of the right hemisphere (R1, 110)=14.98, p=0.01, and a margin effect of condition, such that N170s had a more negative amplitude to direct than to averted gaze (R1, 110)=5.42, p<0.05.
- Latency: There were no significant differences between groups or conditions for N170 latency (p>0.05).

Conclusions

- Males and females with ASD differed in their neural and behavioral responses to faces displaying direct and averted gaze.
- Females with ASD had faster neural responses to gaze shift, and less lateralized response to gaze shift than males with ASD and females with TD. They also displayed stronger gaze lateralization patterns, in line with typically developing peers, than males with ASD.
- Sex-specific brain activity and looking patterns in individuals with ASD highlight the importance of considering sex as a variable in understanding ASD and suggest distinct mechanisms underlying social perception in females with ASD.
- Future work will examine correlates of the neural responses to direct and averted eye contact and other clinical measures of social responsiveness to examine potential sex differences in these relationships.

References

- McNaughton, A., et al. (2017). CTSA Grant Number UL1 TR002439 (McPartland), NIMH R21 MH100139 (McPartland), Autism Speaks Translational/Preclinical Fellowship (Naples), Watson Foundation 1167-1168 (McPartland), Autism Trust 13-00260 (McPartland), NIMH R01 MH107426 (McPartland), Shriners, NIMH R01 MH10173-02(5).

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