Influence of Autistic Traits and Social Anxiety on Gaze Patterns to Faces and Associated Neural Response

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Background

Background:

- Autism Spectrum Disorder (ASD) is characterized by decreased social motivation, as well as increased anxiety and sensory sensitivities.
- Attention, measured via eye-tracking (ET), and brain response, as measured by event related potentials (ERP) are reliable indices of social motivation and social anxiety.
- The N170, a face-sensitive ERP, is slowed and attenuated in ASD; in contrast, individuals with anxiety show faster, enhanced N170s.
- While individuals with ASD show decreased attention to faces and eyes, individuals displaying social anxiety show increased attention to eyes and faces.
- The P1, an early ERP marker of visual attention, has been shown to have greater amplitude in individuals with ASD than in typically developing peers.
- The interplay between anxiety, sensory sensitivities, and ASD and attention/neural response to faces remains unexplored.

Objectives:

- Using EEG and ET, we examined relationships among autistic, sensory, and social anxiety traits and:
  - (1) looking patterns to neutral and fearful face stimuli;
  - (2) brain response to faces; and
  - (3) the relationship between these parameters and self-reported ASD symptomatology, sensory profiles and social anxiety.
- It was predicted that individuals with higher ratings of social anxiety symptoms would look more to the eyes, especially in the fear condition. In addition, we hypothesized that individuals with higher ratings of autistic traits would show an attenuated N170 response to faces and would look less to the eyes. Those with higher anxiety were hypothesized to show an exaggerated and faster P1. We expected that higher ratings of sensory sensitives would also present with a greater P1 amplitude.

Method

Experimental Paradigm:

- Data was collected from 24 neurotypical adults.
- ERPs were recorded concurrently with eye movements during the free-viewing of faces.
- Participants viewed 57 neutral and 57 fearful faces presented in random sequence for 5 seconds.
- Each face was preceded by a 300 ms blank screen and 700-900 ms fixation crosshair.

Clinical Measures:

To measure social anxiety, autistic traits, and sensory profiles, participants completed self-report measures:

- Social Responsiveness Scale (SRS); Autism-Spectrum Quotient (AQ); Social Avoidance and Distress Scale (SAD); Glasgow Sensory Questionnaire (GSQ).

EEG and ET Data Acquisition and Collection:

- EEG recorded at 1000 Hz with a 128-channel Hydrocel Geodesic Sensor net.
- ET data collected using an SR Eyelink-1000 eye-tracking system, sampled at 500 and 1000 Hz.

Method

ERP Preprocessing and Analysis:

- Data were filtered from 0.1-100 Hz. Data were then re-referenced to an average reference, segmented from -200ms to 300 ms relative to stimulus onset, baseline corrected, and artifact detected.
- N170 and P1 were extracted from right occipitotemporal electrodes (See Figure 1). The temporal window was 135-180ms for N170 and 90-120ms for P1.
- Mean and peak amplitude (N170 and P1) and latency (N170 and P1) were included as dependent variables.

ET Analysis:

- ET variables included dwell time in specific Regions of Interest (ROIs; eyes, left/right eyes, between eyes, mouth, and nose), fixation duration and dispersion (see Figure 2).

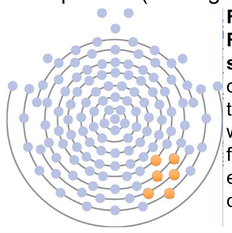

Figure 1. Recording sites. Right occipito-temporal N170 was extracted from depicted electrode cluster.

Figure 2. ET Regions of interest. ROIs include full face, upper and lower face, both eyes, between eyes, nose, mouth, and shirt.

Results

ERP Results:

- There was a significant main effect of condition, such that the fear stimuli elicited a greater N170 mean amplitude than neutral ($F(1,21) = 8.47$, $p < .01$) (Figure 3).
- Higher reports of sensory sensitivities, captured by the GSQ total score, were significantly correlated with larger N170 peaks in both fear and neutral conditions ($r = -.48$, $p = 0.02$) (Figure 4).
- SAD total scores were significantly correlated with the mean P1 amplitude in the neutral condition ($r = -.45$, $p = 0.03$) (Figure 5).

ET Results:

- There was a significant main effect of condition in looking time to the eyes in the fear versus neutral conditions ($F(1,21) = 5.29$, $p = 0.03$) (Figure 6).

ERP and ET Results:

- In the fear condition, later N170 latencies were significantly correlated with N170 latency (Figure 7).

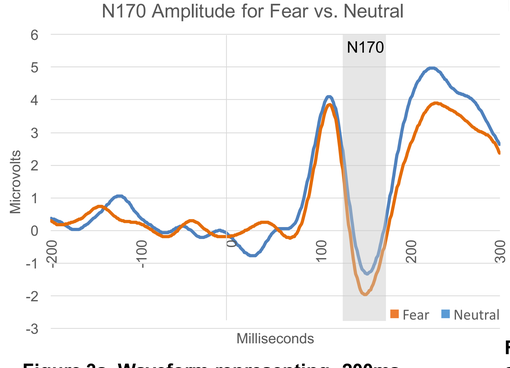

Figure 3a. Waveform representing -200ms to 300ms. Greater N170 amplitude in response to fear faces vs. neutral.

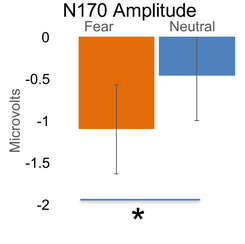

Figure 3b. Differences in N170 amplitudes. N170 amplitude was significantly larger in the fear condition compared to neutral.

Results

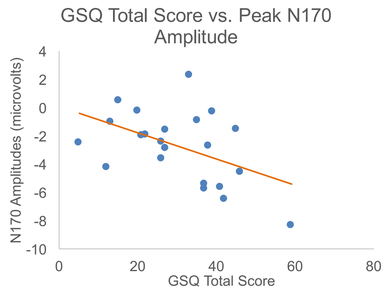

Figure 4. N170 amplitudes were significantly larger for individuals with higher GSQ total scores.

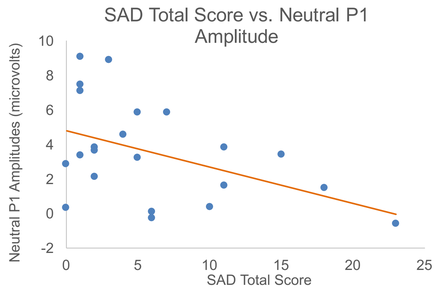

Figure 5. Higher SAD scores correlated with smaller P1 amplitudes in the neutral condition.

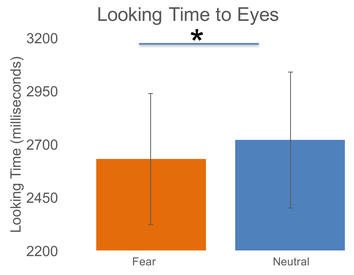

Figure 6. Individuals looked significantly less to the eyes in the fear condition as compared to neutral.

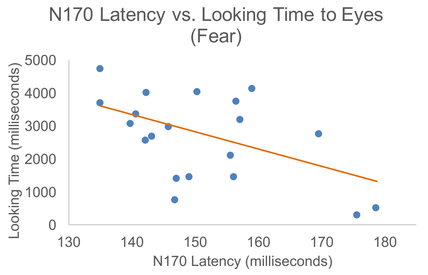

Figure 7. Slower N170 latencies significantly correlated to less looking time to the eyes in the fear condition.

Conclusions

Results revealed relationships among autistic traits, social anxiety, and sensory sensitivities and both ET and ERP measures.

- Both ET and ERP revealed distinct response patterns to fear versus neutral faces.
- It was expected that social anxiety would impact N170 amplitude and latency, but instead differences (smaller amplitudes) were observed at the P1. This suggested a suppressing effect of social anxiety on lower-level visual attention to faces.
- The hypothesis that those with greater sensory sensitivities would have larger P1 responses was not supported. However, such sensory profiles were associated with larger N170 responses to both fear and neutral faces. Sensory hyper and hypo-sensitivities are often reported in ASD, and, in this study, we see that in a social context variance in sensory profiles can be explained by differences in brain response.
- In response to fear conditions, less looking time to the eyes resulted in slower N170 latency. This link between neural activity and looking behavior may have implications for interventions if looking to the eyes can be taught, thereby changing the corresponding N170.

This study warrants further exploration in a larger sample to confirm these results in individuals with a diagnosis of ASD.

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