

Background

- Difficulties with eye-contact, maintaining shared gaze, and following gaze represent some of the earliest occurring symptoms of ASDs. While difficulties with eye-contact are clinically diagnostic, experimental investigations of gaze processing have yielded mixed results.
- Prior research investigating attention to faces and gaze processing in ASD has relied on passive viewing of static or dynamic social information, whereas clinical differences are most apparent in interactive contexts.
- Passive viewing paradigms suggest that variability in attention to the eyes of the face (measured with eye tracking) and temporally early brain response (P100, N170; measured with electrophysiology) are associated with atypical gaze processing in ASD.
- Our objectives were to: (1) investigate neural processing of interactive eye-contact by measuring brain activity in response to direct vs. averted gaze; (2) investigate attention by measuring eye-movements prior to and following interaction with an onscreen face; and (3) evaluate the relationship between neural and attentional markers of interactive eye-contact and clinical characteristics in children with ASD and typical development (TD).

Method

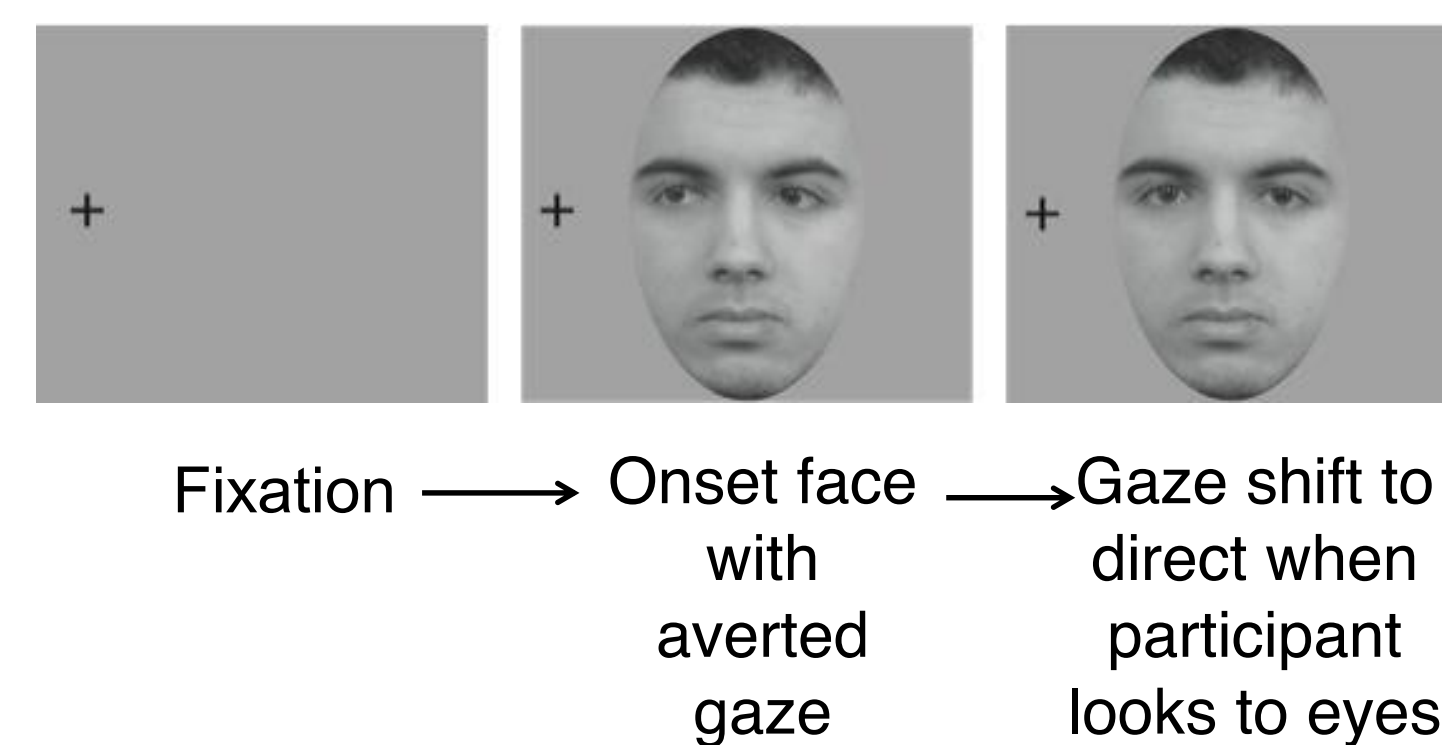
Sample						
Group	Sex	N	Age	Max Age	Min Age	IQ
ASD	male	46	14.02	18.5	8.4	105
TD	male	23	14.74	18.3	9.6	103
ASD	female	15	14.23	18.3	9.5	106
TD	female	17	12.91	16.6	9.0	104

Experimental Paradigm:

- Participants were presented with 112 faces matched for low-level visual features and modified such that only the eyes on the face moved in response to gaze.
- Contingent upon participants' fixating on the eyes of the onscreen face, the face responded by shifting eye gaze (from direct to averted or averted to direct).

Figure 1. Trial Structure.

After participants fixated on a crosshair for ~300ms (panel 1), a face with either direct or averted gaze was presented (panel 2). After the participant looked to the eyes for ≥500ms, a second face with shifted gaze (panel 3) was presented for 600ms. Inter-trial interval ranged from 200-1200ms.



Preliminary Results

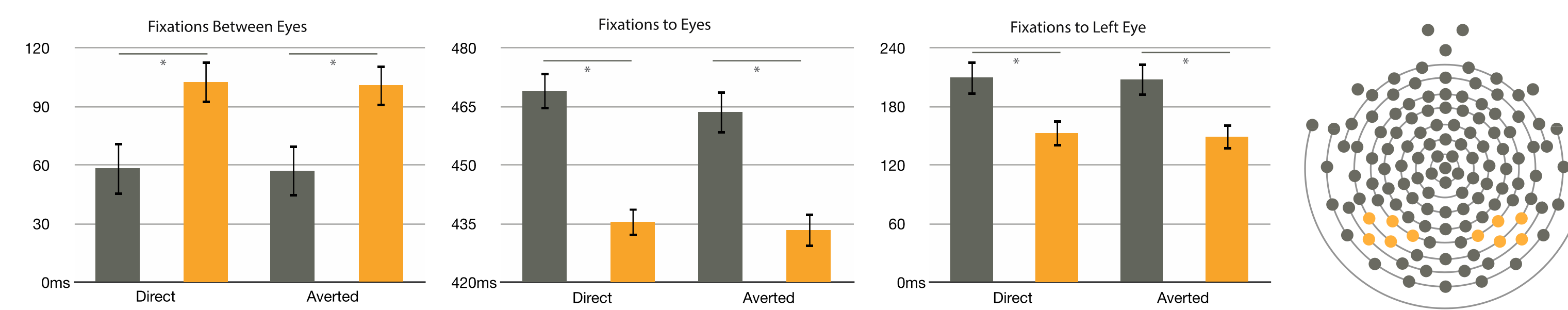
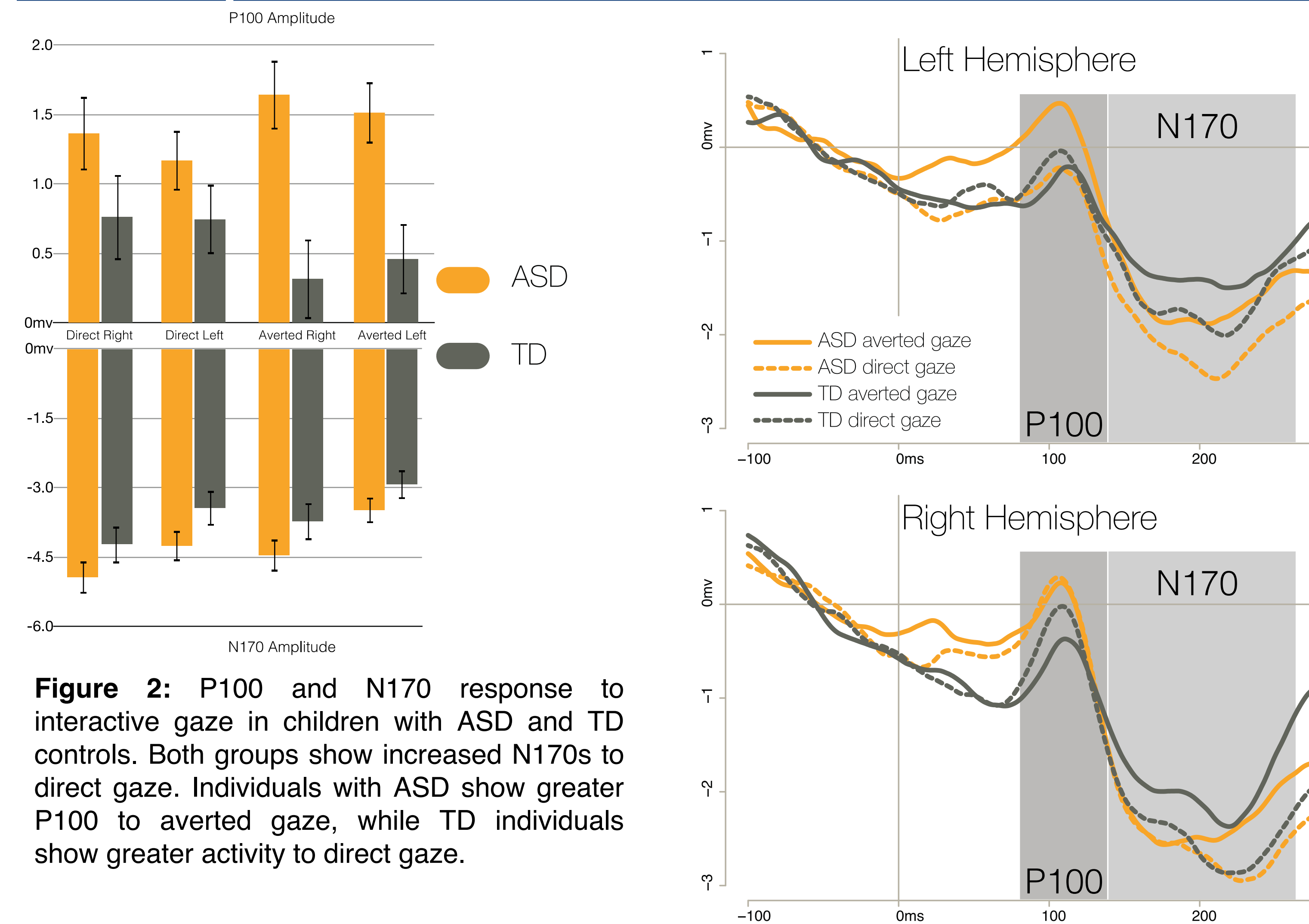


Figure 3: Fixation time to regions of the face by group and condition

Figure 4: Electrode recording sites

P100

- Amplitude:** An interaction between Condition and Group indicated that the individuals with ASD had larger P100s to averted gaze while TD individuals had larger P100s to direct gaze [$F(1,79) = 4.68, p = .03$]. Across conditions individuals with ASD had larger P100s to gaze [$F(1,79) = 7.79, p = .007$].

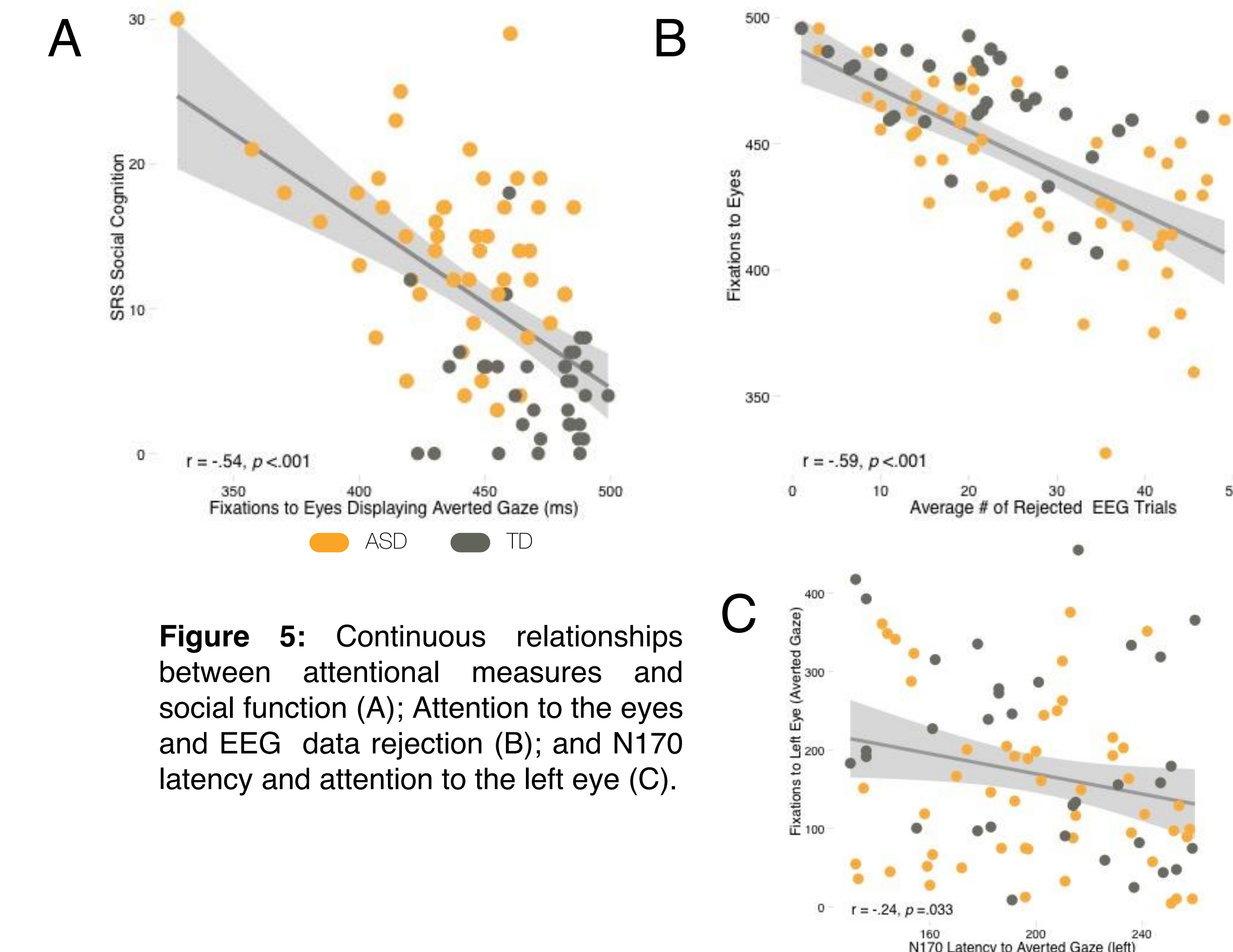
N170

- Amplitude:** A main effect of Condition indicated that, across groups, N170s to direct gaze were more negative than to averted gaze [$F(1,79) = 4.98, p = .028$]. A main effect of Hemisphere revealed larger amplitude N170s in the right hemisphere [$F(1,79) = 10.62, p = .002$].
- Latency:** A Condition by Hemisphere interaction indicated that direct gaze elicited faster N170s in the left hemisphere while averted gaze elicited faster N170s in the right hemisphere [$F(1,79) = 6.88, p = .01$].

Eye-Tracking:

- A main effect of Group revealed that individuals with ASD looked *less* to the eyes of the face following gaze change [$F(1,99) = 27.95, p < .001$].
- A main effect of Group revealed that individuals with ASD looked *less* to the left eye of the face following gaze change [$F(1,99) = 7.45, p = .008$].
- A main effect of Group revealed that individuals with ASD looked *more* to the bridge of nose (between eyes) following gaze change [$F(1,99) = 6.871, p = .01$].

Preliminary Results



Conclusions

- In an interactive paradigm, across participants with ASD and TD, direct gaze elicited greater face specific neural activity (N170) than averted gaze. This finding suggests that reciprocal eye contact recruits greater face-specific brain activity than gaze aversion.
- Increased attention to eyes was associated with faster N170s in the left hemisphere, suggesting that individual differences in looking patterns may be influenced by early social brain activity.
- Typically developing individuals showed larger P100s to reciprocal eye contact, while individuals with ASD exhibited larger P100s to averted gaze. This finding suggests that typically developing individuals may prioritize social aspects of gaze (e.g., mutual eye-contact), whereas individuals with ASD may prioritize more directly functional aspects of gaze, such as directing attention.
- A lack of group differences at the N170 suggests that, for those children with ASD who maintain eye-contact during reciprocal interactions, brain activity is not significant from their typically developing peers
- While participants were required to look to the eyes of the face, typically developing individuals primarily looked at the right eye of the face (left side on-screen), while individuals with ASD looked significantly more between the eyes of the face. These data suggest that even when instructed to look to the eyes of the face, individuals with ASD exhibit atypical looking patterns.
- Increased attention to the eyes of the face correlated with better social function suggesting that the ability to maintain reciprocal eye-contact in an interactive context is highly correlated with symptom presentation.
- The strong relationship among attention to eyes, social function, and rejected EEG data due to participant eye-movement suggests that: 1) individuals with ASD have difficulty maintaining attention to the eyes of onscreen faces, and 2) those individuals with ASD who maintain gaze to the eyes of onscreen faces exhibit better social function.