Neural Response to Biological Motion in Males and Females with ASD

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Background

- Recognition of biological motion is an early developing aspect of social brain development. Individuals with ASD show reduced visual preference for biological motion versus non-biological motion[1] and attenuated brain response to biological motion.[2]
- Electrophysiological investigations of biological motion have revealed a right lateralized N200 sensitive to biological vs. scrambled motion[3] and atypical patterns of lateralization in ASD.[4]
- Although previous research has identified attenuated brain response to social information in females with ASD[5], sex differences in electrophysiological response to biological motion in ASD remain unexplored.
- We predicted that individuals with ASD would display attenuated brain response to biological motion and atypical patterns of lateralization. We predicted that females with ASD, relative to males, would show attenuated brain response to biological motion.

Method

Participant Demographics

Group	Sex	Age	N	IQ
ASD	F	13.64	16	113
ASD	M	12.05	19	100
TD	F	11.27	13	107
TD	M	12.56	18	107

Experiment presentation

- Participants viewed 1000ms sequences of biological or scrambled motion presented with Eprime 2.
- Stimuli were presented in 4 blocks of 26 trials in random order.

Data Processing

- EEG was recorded at 500hz using a 128 electrode Hydrocel Geodesic Net and Netstation 4.5.
- EEG was segmented from -100 to 900ms peristimulus onset.
- Data were filtered from .1 to 100hz.
- All trials were manually inspected to reject artifacts
- Data were average referenced and baseline corrected to 100ms prestimulus.
- Peak amplitude and latency to peak were extracted from left and right occipitotemporal electrodes for P100 (120-185ms) and N200 (190-300ms). Mean amplitude was extracted for a slow wave (400 to 900ms).

Data Analysis

- Effects of Condition (Biological/Scrambled), Sex, Diagnostic Group, and Hemisphere were analyzed using separate repeated measures ANOVAs for the P100, N200, and slow wave.

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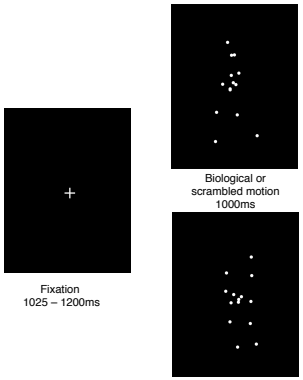

- Stimuli were adult male and female point light walkers generated from the CMU motion capture database http://mocap.cs.cmu.edu/
- Scrambled walkers were generated for each walker by scrambling the spatial starting position and temporal phase of each point

Figure 1: Trial structure depicting biological and scrambled motion

Preliminary Results

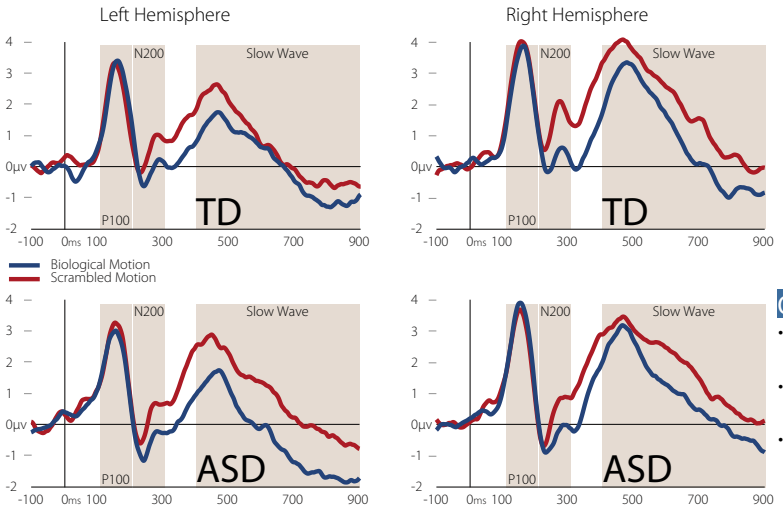

Figure 2: Left and right lateralized waveforms depicting brain response to biological and scrambled motion

Funding sources
NIMH R01 MH100028 (Pelphrey)
NIMH R01 MH100173-01A1 (McPartland)
NIMH RO1 MH100173-02S1 (McPartland)
NIMH R21 MH091309 (McPartland)
Patterson Trust 13-002909 (McPartland)
Autism Speaks Postdoctoral Fellowship (Naples)
Autism Science Foundation (Naples)
Slifka-Ritvo Innovation in Autism Research Award (Naples)

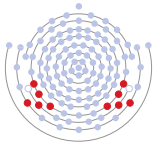

Figure 3: Electrode recording sites

Preliminary Results

P100

- Amplitude: A main effect of sex indicated that females in both groups had smaller P100s [$F(1,63) = 14.64$, $p < .01$].
- Latency: A condition by group interaction indicated that individuals with ASD had faster P100s to biological motion [$F(1,63) = 5.59$, $p = .02$].

N200

- Amplitude:
  - A main effect of condition indicated that biological motion was more negative than scrambled motion [$F(1,63) = 6.79$, $p < .01$].
  - A condition by hemisphere by group interaction revealed greater differentiation between biological and scrambled motion in the right hemisphere in TD [$F(1,63) = 3.370$, $p = .07$; Figure 4]. This was observed as a significant hemisphere by condition interaction in the TD group [$F(1,30) = 4.39$, $p = .045$]. This effect was not observed in the ASD group $F(1,33) = .57$, $p = .46$].
  - Planned comparisons indicated a main effect of condition in TD [$F(1,30) = 4.02$, $p = .05$] but not ASD [$F(1,33) = .02$, $p = .90$].
  - In ASD, a gender by hemisphere interaction indicated left lateralization for males and right lateralization for females [$F(1,33) = 3.00$, $p = .09$].
- Latency: A main effect of condition indicated that the N200 peaked later for biological than scrambled motion [$F(1,63) = 23.48$, $p < .01$].

Slow Wave

- Amplitude: A main effect of condition indicated more negative amplitude for biological motion [$F(1,63) = 15.49$, $p < .01$]. A main effect of hemisphere indicated more negative amplitude in the left hemisphere [$F(1,63) = 7.87$, $p < .01$]. A group by hemisphere by condition interaction indicated greater differentiation of biological motion in the left hemisphere in ASD and the right hemisphere in TD [$F(1,63) = 3.11$ $p = .08$; Figure 5].

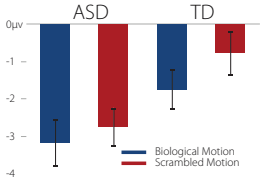

Figure 4: Right hemisphere N200 Amplitude

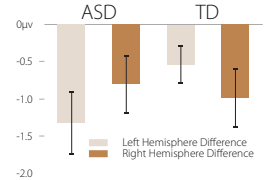

Figure 5: Difference between biological and scrambled motion across the slow wave by group and hemisphere

Conclusions

- Distinct neural responses differentiated biological motion from scrambled motion at both the N200 and a subsequent slow wave.
- Individuals with ASD did not show differentiation of biological and scrambled motion at an early index of social perception (N200). However, differentiation was observed at the subsequent slow wave (400-900ms).
- TD individuals, but not those with ASD, displayed expected right lateralization at the N200. At the subsequent slow wave, TD individuals displayed right lateralization, while those with ASD showed increased differentiation of biological motion over left hemisphere.
  - These results suggest a disruption in the early time course of social perception that may influence the later differences in lateralization in ASD.
- Across groups, females displayed smaller amplitudes at an early sensory component (P100).
- Atypical left-lateralized patterns of brain activity were more pronounced in males with ASD, while females with ASD displayed a more normative right lateralized pattern of activity at the N200.
- Future analyses will include a a sample of unaffected siblings of individuals with ASD.
- We will also incorporate individuals with a wider range of cognitive and adaptive ability to explore the relationship between clinical characteristics, sex, and brain activity.