Background

- Electrophysiology studies suggest atypical visual processing in individuals with ASD, as indexed by Visual Evoked Potentials (VEP) with lower P100 amplitudes in individuals with ASD as compared to TD (Kovarski et al., 2018).
- Eye-tracking studies suggest individuals with ASD exhibit more circumscribed and perseverative visual attention compared to TD individuals in Visual Search (VS) paradigms (Sasson et al., 2008, 2011).

Our question is: Are visual processing differences associated with differences in higher-order behaviors of visual control?

Methods

The Autism Biomarkers Consortium for Clinical Trials (ABC-CT; McPartland) is a multi-site evaluation of ASD biomarkers.

Sample Characteristics

<table>
<thead>
<tr>
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<th>ASD</th>
<th>TD</th>
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<tbody>
<tr>
<td>Age (years)</td>
<td>8.6 (2.0)</td>
<td>8.6 (1.6)</td>
</tr>
<tr>
<td>Full Scale IQ</td>
<td>99 (10.0)</td>
<td>115 (12.0)</td>
</tr>
<tr>
<td>Verbal IQ</td>
<td>97 (10.1)</td>
<td>117 (13.4)</td>
</tr>
<tr>
<td>Performance IQ</td>
<td>102 (15.9)</td>
<td>101 (14.2)</td>
</tr>
<tr>
<td>Vineland Adaptive Behavior Composite</td>
<td>77.1 (15.5)</td>
<td>103.1 (14.2)</td>
</tr>
<tr>
<td>ADOS Communication Severity</td>
<td>78.1 (13.9)</td>
<td>91.1 (12.2)</td>
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<td>78.1 (13.9)</td>
<td>91.1 (12.2)</td>
</tr>
<tr>
<td>ADOS BDI Severity Score**</td>
<td>78.2 (2.1)</td>
<td>78.2 (2.1)</td>
</tr>
</tbody>
</table>

Experiment Paradigms

VEP Stimuli

- Black & white checkerboards that reversed their phase (i.e., black to white or white to black) every 100ms for a longer duration (Figure 1).
- 4 blocks of 32 trials for 204 trials
- Mean luminance of 50cd/m² and contrast of 99%

VEP Stimuli

- One cue, five distractors placed at an equal distance from center of screen (Figure 2).
- 4 blocks of 3 trials (250ms) for 12 trials (interchanged with other paradigms and split across two days).

Data Acquisition and Processing

- EEG data: (1000Hz with 128-channel HydroElectroGel Sensor net).
- P1 amplitude and latency calculated from 60-900ms min. fixation time: 130ms, respectively, from Occipital Medline (Figure 3).
- Secondary dependent variables: N1-P1 amplitude/latency.
- Removal of 60Hz line-noise, reference to average reference, baseline corrected, artifact detected (150ms) threshold.

Methods Continued

- ET data: 8Hz Eyelink 1000 Plus & processed at 500Hz.
- Fixations: 1° spatial threshold and 1° duration/valid looking time (Fixation’s) & fixation duration/Saccade count.
- Secondary dependent variables: Saccade duration/valid looking time (Saccade’s).
- Static Regions of Interest (ROI) images used (Figure 4).
- Trials validity: > 50% on-screen duration & > 3° calibration error.

Results

Exploring the effect of its visual processing and visual search

- No effect of age, IQ, sex or group (ASD vs. TD) in P1 amplitude (Figures 5 & 6).
- No between-group differences in any of the other dependent variables: N1 amplitude/latency, P1-N1 amplitude/latency.

Exploring the relationships between visual processing & search

- No significant relationships between VEP variables and ET variables with or without outliers. Outliers located via online labeling tool using a multiplier of 2.2 (Hosain & Fyffe, 1987).

Exploring the relationships between ERPET and sample characteristics

Correlations were calculated using SPSS:

In TD
- N1 Amplitude & Full Scale IQ (r=0.55, p = 0.03).
- N1 Amplitude & Vineland Adaptive Behavior Composite (r=0.55, p = 0.03).

In ASD
- Fixation% & ADOS SA Severity (r=0.26, p = 0.05).
- Saccade% & ADOS SA Severity (r=0.28, p = 0.04).

Results Continued

Discussion

- Contrary to prior findings on Visual Search, children on the spectrum spend less percentage of time perceiving or fixating as compared to TD and spend a higher percentage of time scanning or sampling the scene. This effect does not seem to be specific to social vs. non-social stimuli and the trend of reduced visual scanning is associated with more autism symptomatology.
- Modest correlations with sample characteristics suggest that TD amplitude values are indexing some aspect of the continuum of functioning level and adaptive behavior across the TD group.
- P1(N1) amplitude and latency values and eye tracking fixation measures were not found to be related in this study.
- Might be due to task differences between the EEG and ET paradigms.
- Could signal a mechanistic disconnect between lower-level visual processing and higher-order visual search behavior.

References