Background

• Restricted and repetitive behaviors are a core symptom of autism spectrum disorder (ASD), including motor stereotypes, cognitive rigidity, and problems with attention processing.
• Several studies have noted differences in oculomotor movements such as blinks and saccades between individuals with ASD and those typically developing (TD) peers.
• Characteristics of these oculomotor movements have also been linked to behaviors and biological systems that may underlie the stereotypes and cognitive rigidities often seen in ASD; however, scant research has examined relationships between variability in spontaneous eye-movement and clinically meaningful individual differences.
• Spontaneous eye movements may provide a unique means of examining low-level neurotransmitter dynamics influencing autistic traits.
• Based on prior literature, we predicted differences in both blink rate and characteristics of spontaneous saccadic eye movements between children with ASD and TD children, such that spontaneous eye movements and blinks would be more frequent in children with ASD.
• We specifically expected to see differences in the 4-10 Hz frequency characteristics of eye movements, which have been associated with neural mechanisms of attentional control and cognitive flexibility, such that children with less cognitive flexibility would show a greater degree of regularity in eye movements.

Methods

Participants

• Clinical and eye-tracking data were collected from 51 participants (see Table 1) recruited from the New Haven, CT, Boston, MA, Los Angeles, CA, Durham, NC, and Seattle, WA metropolitan areas as a part of the Autism Biomarkers Consortium for Clinical Trials (ABC-CT) feasibility study.

Table 1

<table>
<thead>
<tr>
<th>Group</th>
<th>n (n males)</th>
<th>Mean Age (Y)</th>
<th>Min. Age (Y)</th>
<th>Max. Age (Y)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASD</td>
<td>25 (20)</td>
<td>7.77</td>
<td>4.42</td>
<td>11.3</td>
</tr>
<tr>
<td>TD</td>
<td>26 (17)</td>
<td>6.59</td>
<td>4.01</td>
<td>11.4</td>
</tr>
</tbody>
</table>

Behavioral Assessment:

• Stereotypy and rigidity were assessed using:
  • Aberrant Behavior Checklist (ABC) stereotypy standard score
  • Autism Impact Measure (AIM) frequency of restricted behavior subscale
  • Behavior Assessment System for Children (BASC-3) adaptability and attentional control subscales

Rigid and Stereotyped Behaviors

• Summary statistics are presented for measures of rigid and stereotyped behaviors for each group (Table 2).

Table 2

<table>
<thead>
<tr>
<th>Measure</th>
<th>TD ASD</th>
<th>Welch t-test</th>
<th>t df</th>
</tr>
</thead>
<tbody>
<tr>
<td>Full-Scale IQ (DASS-II)</td>
<td>114 (9.34)</td>
<td>91.1 (19.5)</td>
<td>-5.33 34.1 &lt;0.01</td>
</tr>
<tr>
<td>ABC Stereotypy Standard Score</td>
<td>0.08 (0.39)</td>
<td>4.38 (3.33)</td>
<td>6.28 23.4 &lt;0.01</td>
</tr>
<tr>
<td>AIM Frequency of Restricted Behavior</td>
<td>10.3 (2.92)</td>
<td>20.3 (7.37)</td>
<td>6.07 28.1 &lt;0.01</td>
</tr>
<tr>
<td>BASC-3 Adaptability</td>
<td>58.3 (8.53)</td>
<td>42.0 (11.4)</td>
<td>-5.58 40.4 &lt;0.01</td>
</tr>
<tr>
<td>BASC-3 Attentional Control</td>
<td>43.4 (7.33)</td>
<td>64.6 (6.19)</td>
<td>10.96 49.9 &lt;0.01</td>
</tr>
</tbody>
</table>

Conclusions

• These data suggest that the blink rate and frequency dynamics of spontaneous eye movements in children with ASD differ from that of their TD peers.
• Among children with ASD, eye movement rhythmicity exhibited a stronger frequency component from 4-10 Hz, which was further modulated by the degree of restrictive behavior displayed.
• That this frequency band has been implicated in attentional processing and cognitive control suggests that further examination of spontaneous oculomotor dynamics in this range may have potential as a biomarker of processes relevant to RRBs.
• Future research should examine relationships between the frequency dynamics of oculomotor movements and stereotopy and rigidity in ASD in both spontaneous and more structured eye-tracking paradigms.
• Frequency-spectrum-wide group differences in power suggest a possible confounding influence of noise in data; future research should aim to reduce noise in data collection and to further characterize any systemic differences in data quality between groups.

References