The Cost of Attentional Engagement: Target Switching during Visual Search in 2-Year-Old Toddlers with ASD

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Background
Children with ASD exhibit over-focused attention at times and excessive distractibility at other times. The development of attentional factors that contribute to these seemingly contradictory behaviors are not clear.

Voluntary attentional control is fundamental for effective visual exploration and learning (Rothbart & Posner, Dev Rev, 2015). Top-down (or endogenous) control is driven by 'internal' factors, and enables voluntary attentional selection. Bottom-up (or exogenous) control is driven by 'external' factors, and results in involuntary attentional selection.

Earlier, we found that young toddlers with ASD are able to deploy their visual attention in a highly goal-driven manner (Blaser et al., 2014, Sci Rep; Smith et al., 2014, VSS). Previous research suggests they may be inefficient at responding to changes in the environment (Greenaway & Plaisted, 2005, Psych Sci).

Objectives
Investigate the ability of toddlers with and without ASD to flexibly deploy attention to a target in the face of competing, previously relevant (and rewarded) distractions.

A unique aspect of our paradigm is that it does not require verbal instructions, making it ideal for populations with weak language skills (see Kaldy et al., 2011, Dev Sci).

Participants

<table>
<thead>
<tr>
<th></th>
<th>ASD Mean (SD)</th>
<th>TYP Mean (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>22</td>
<td>23</td>
</tr>
<tr>
<td># Females</td>
<td>1</td>
<td>15</td>
</tr>
<tr>
<td>Age Months</td>
<td>27.0 (4.7)</td>
<td>24.4 (6.2)</td>
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Mullen:
VR 36.0 (9.3) 57.3 (10.9)
FM 32.7 (10.6) 48.7 (7.1)
RL 25.6 (11.7) 47.8 (12.4)
EL 30.5 (8.7) 48.6 (11.9)
ELC 65.9 (12.2) 101.3 (13.5)

ADOS CSS: 8.1 (1.7)
RRB 8.2 (1.3)
Total 8.8 (1.5)

Conclusions
- Both ASD toddlers and age-matched TYP controls found the target more often than the non-target in Phase 1 (p < 0.05), suggesting both groups noted the special status of the target.
- Across Phases, TYP toddlers appeared relatively unaffected by the target switch. They found the target more often than the non-target in both Phase 2 (p = 0.08) and Phase 3 (p < 0.05).
- ASD toddlers appeared unable to switch targets in Phase 2 (p = 0.68). In Phase 3 they found the target more than the non-target (p < 0.05).
- However, the above finding was qualified by a stimulus interaction. ASD toddlers for whom the apple was the target in Phase 1 did not switch targets (to the carrot) in Phase 2, and continued searching for the non-target despite it no longer being rewarded. However, ASD toddlers for whom the carrot was the target in Phase 1 did switch targets (to the apple) in Phase 2. Such stimulus specific effects were not obvious for TYP toddlers.
- In conclusion, ASD toddlers are capable of deploying attention in accordance with task goals, but this depends on stimulus properties.