Performance-Monitoring and Evaluative Control in High Functioning Autism

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Performance Monitoring and Evaluative Control in High Functioning Autism

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Key Terms:

ASD = Autism Spectrum Disorder
ERP = Event-Related Potential
ERN = Error Related Negativity
Pe = Post-Error Positivity

AIMS

1. Understanding the neurobiology of how children with ASD make mistakes has implications for understanding biological causes and informing intervention strategies
2. This study aimed to determine how response monitoring (i.e., learning from mistakes) differs between those with ASD and controls

BACKGROUND

• ASD is a neurodevelopmental disorder characterized by qualitative impairments in social interaction and communication skills, and a variety of behavioral deficits.
• Decision making difficulties in ASD may arise in part from impaired awareness of feedback, including negative feedback.
• The error-related negativity (ERN) and post-error positivity (Pe) are brain wave components related to the response to mistakes, measured by EEG for evoked-response potential (ERP) tasks
• Current theories suggest the ERN reflects automatic performance-and error-monitoring while the Pe reflects error-processing and awareness.
• As reflections of the response monitoring system, these components have direct behavioral implications in self-monitoring and decision-making in social-emotional processes (Crowley et al., 2009).
• Findings from such paradigms may be especially helpful for elucidating individual differences across the autism spectrum (Henderson et al., 2006).

METHODS

• ASD was characterized using both the ADOS-G (total social communication score >7) and the SCQ (total score >15).
• High-density ERPs were acquired while 25 ASD participants and 25 matched controls performed a modified version of the Eriksen Flanker task over 400 trials.
• Flanker task requires the subject to decide if an arrow presented in the center of the screen with 4 flanking arrows is pointing left or right. Thus, the subject is forced to choose very quickly (rate of 1 sec) if the arrow is pointing in a direction congruent (i.e., “<<<<”) or incongruent (i.e., “<<<”) with the flanking arrows.
• Response-locked ERPs were separately averaged for correct and error trials.

BEHAVIORAL RESULTS

One-way ANOVA Analyses of ERN and Pe

<table>
<thead>
<tr>
<th>Effect</th>
<th>F (1,45)</th>
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</thead>
<tbody>
<tr>
<td>ERN Accuracy</td>
<td>37.54***</td>
</tr>
<tr>
<td>Accuracy * Group</td>
<td>3.97*</td>
</tr>
<tr>
<td>Pe Accuracy</td>
<td>38.37***</td>
</tr>
<tr>
<td>Accuracy * Group</td>
<td>0.71</td>
</tr>
</tbody>
</table>

• We found a significant difference in accuracy between the two groups for the ERN, but not for the Pe.
• We did not find an association between Verbal IQ and the ERN in ASD, but this association was significant for the control group.
• Behavioral inhibition was significantly associated with the difference score between correct and incorrect trials in the Pe, driven by a significant positive correlation between the Pe and behavioral inhibition.

CONCLUSIONS

• The ERN offers the potential for rich insight into response monitoring in ASD, but task-specific and sample-specific differences across studies have thus far preclude a clear understanding of the phenomenon.
• We encourage further studies that give explicit attention to important factors of diagnostic severity, cognitive function, anxiety and personality to help identify possible subtypes of autism that could be characterized by reliable physiological measures such as the ERN.

Participants

<table>
<thead>
<tr>
<th></th>
<th>n</th>
<th>Age (Mean ± SD)</th>
<th>Full Scale IQ (Mean ± SD)</th>
<th>SCARED Total (Mean ± SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASD</td>
<td>24</td>
<td>13.48 (2.03)</td>
<td>109.00 (13.55)</td>
<td>21.78 (12.85)</td>
</tr>
<tr>
<td>TDC</td>
<td>23</td>
<td>14.24 (2.72)</td>
<td>111.17 (14.18)</td>
<td>9.35  (6.18)</td>
</tr>
</tbody>
</table>

Errors (ERN)

Correct Responses

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</tbody>
</table>

Our ERP recordings use the 128-channel EGI Geodesics system

Event-Related Potentials in ASD vs. Controls

- The ASD group demonstrated little difference in their response to errors and correct trials
- The control group demonstrated larger differences in their response to errors and correct trials than the ASD group

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