Externalizing behaviors in autism spectrum disorder modulate neural responses during a novel interactive social paradigm

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Background

- Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by (1) social and communication deficits and (2) restricted, repetitive behaviors
- Gaze direction is an important part of nonverbal social communication
  - Direct: analysis of faces;↑ approach-oriented emotions (anger, joy)
  - Averted: orientation of spatial attention, shared attention;↑ avoidance-oriented emotions (fear, sadness)
- EEG neural responses to gaze direction is atypical in both ASD and controls associated with externalizing behavior (e.g., conduct disorder)
  - May be related to aberrant development of attention
- However, there have been few investigations into the potential influence of externalizing behaviors on neural responses to social information in ASD

Objective of study: to examine whether externalizing behavior modulates EEG derived event-related potentials (ERPs), N170, P100 to social information in individuals with ASD compared to typically developing (TD) controls

Sample characteristics:

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>68±34M</th>
<th>Age (SD)</th>
<th>IQ (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASD</td>
<td>40</td>
<td>68±34M</td>
<td>14.3±2.8</td>
<td>109.5±21.6</td>
</tr>
<tr>
<td>TD</td>
<td>41</td>
<td>19±22M</td>
<td>13.2±2.6</td>
<td>109.5±12.5</td>
</tr>
</tbody>
</table>

Methods

EEG Data Acquisition and Collection

EEG was recorded at 1000 Hz with a 128 electrode HydroCel Geodesic Sensor net.

Trial Structure/Experimental Paradigm (Figure 1)

EEG was recorded while the participant underwent a gaze-contingent viewing paradigm. Participants viewed 112 faces that were matched on low-level visual features. The faces responded to the participant’s gaze by looking at (direct gaze) or away from (averted gaze) the participant.

Event-related potential (ERP) analysis

The amplitudes and latencies of the N170 (150-300ms), a face-sensitive ERP, and P100 (50-100ms), an ERP associated with early sensory processing were extracted from electrodes over left and right occipitotemporal regions (see Figure 2).

Data were filtered at 0.1 to 30Hz and segmented from 100 to 600ms.

Results

Figure 3: Participants with ASD exhibited significantly greater parent-reported externalizing maladaptive behavior than TD participants, as determined by the CBCL’s Externalizing T-Scores.

A. N170 latency with averted gaze (left hemisphere, (b=1.36, p=0.04), (b=0.10, p=0.04))

B. P100 latency with averted gaze (right hemisphere, (b=1.31, p<0.001), (b=0.13, p=0.04))

C. P100 amplitude with direct gaze (right hemisphere, (b=0.70, p=0.03), (b=0.01, p=0.22))

Figure 4: N170 and P100 response to interactive gaze in the ASD and TD group over the (A) left hemisphere and (B) right hemisphere.

Figure 5: Analysis of N170 peak amplitude revealed that there was a significant main effect of gaze [left hemisphere, F(1,150)=4.84, p=0.04], which showed that across groups the N170 was enhanced in direct gaze compared to averted gaze [6±100ms-2.31, p=0.04] but no main effect of group and no interaction between group and gaze (p=0.05). The analysis of N170 latency, P100 peak amplitude and latency revealed that there were no main effects of group or gaze and no interaction between group and gaze (p=0.05).

Figure 6: In ASD but not TD, externalizing maladaptive behaviors significantly predicted:

A. N170 latency with averted gaze [left hemisphere, F(1,150)=0.04, p>0.05]

B. P100 latency with averted gaze [right hemisphere, (b=1.31, p<0.001), (b=0.13, p=0.04)]

C. P100 amplitude with direct gaze [right hemisphere, (b=0.70, p=0.03), (b=0.01, p=0.22)]

Conclusions

Enhancement of the face-sensitive N170 to direct gaze across diagnostic groups suggest similar response to mutual gaze at initial stages of face perception

Externalizing behaviors were associated with gaze perception in children with ASD but not TD

In children with ASD, more severe externalizing behaviors were associated with slowed visual and facial processing in an avoidance-oriented social context and with more impaired visual processing in an approach-oriented one

These findings suggest that externalizing behavior may be useful in guiding strategies to stratify a heterogeneous ASD population to advance the objective of individualized, targeted therapies

Reference


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