Contrasting ERP patterns linked to face processing and recognition in Autism and Williams syndrome


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Introduction

Autism Spectrum Disorder (ASD) and Williams Syndrome (WS) are neurodevelopmental disorders with nearly complementary profiles of social interest and cognitive proficiencies and deficits. WS has a specific genetic etiology caused by the deletion of approximately 25 genes on chromosome 7, whereas ASD is diagnosed as a collection of atypical behaviors particularly in communication and social interactions and does not have a known etiology.

Although there is individual variability in each group, most individuals with WS are often socially advanced and have relative proficiencies in face processing accompanied by heightened attention to faces (1,3). In contrast, most individuals with ASD tend to avoid making eye contact and are socially avoidant. Yet, behavioral and electrophysiological evidence suggests some similarities across groups. Individuals with these disorders have been shown to exhibit feature-based rather than configural processing of faces, fail to show typical face-inversion effects, and display abnormal patterns of brain activity and organization for faces (2,5,6).

The present study examined ERP patterns linked to the processing and recognition of upright and inverted faces in three groups of participants: ASD, WS and typical controls (TC). Previous findings suggest that individuals with WS display an abnormal small negativity at 100 ms (N100), an abnormally large negativity at 200 ms (N200) post stimulus, as well as unique match/mismatch effects (amplitude greater to mismatched target) during later processing.

Hypotheses for the present study were: (1) Individuals with ASD will show a smaller N200, linked to decreased attention to faces, as compared to both TC and WS, (2) ASD and WS groups will exhibit ERP patterns congruent with their attention-mediated tendencies toward processing face stimuli.

Methods

Participants

<table>
<thead>
<tr>
<th>Participants</th>
<th>ASD</th>
<th>WS</th>
<th>N100</th>
<th>N200</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gender</td>
<td>9 M, 1 F</td>
<td>16 M, 4 F</td>
<td>8 M, 2 F</td>
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</tr>
<tr>
<td>Mean Age</td>
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<td>27.5 y</td>
<td>26.9 y</td>
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</tr>
<tr>
<td>Age Range</td>
<td>17-46 y</td>
<td>17-40 y</td>
<td>16-45 y</td>
<td></td>
</tr>
<tr>
<td>P300</td>
<td>90</td>
<td>68.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>VQT</td>
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<td></td>
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<tr>
<td>P30Q</td>
<td>97.3</td>
<td>68.5</td>
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</tr>
</tbody>
</table>

Stimuli

• Participants viewed 38 digitized black and white photographic pairs of upright or inverted faces (half female) on a computer screen.

• On one half of the trials, the identity of the two faces in the pair matched, while on the remaining trials it did not.

• Half of the images in each condition were presented upright, while the other half were presented inverted.

Task

• Tasks consisted of the sequential presentation of two faces. Participants were asked to indicate a button press whether the second face (target) matched or did not match the first (prime).

Procedure

• EEG was recorded using a 16-channel tin electrode cap with a bandpass of .05 to 100 Hz. All electrodes were referenced to the average of the left and right mastoids.

Results

Accuracy and reaction time

• Means and standard errors for accuracy (in percent correct) and reaction time are displayed in Table 2.

• It was predicted that the orientation effect would be stronger for TC than the clinical groups.

• The predicted group X orientation interactions were significant for both accuracy and reaction time.

• All three groups were more accurate, whereas only TC were also faster, for upright than inverted faces.

Table 2

<table>
<thead>
<tr>
<th>Group</th>
<th>Matched</th>
<th>Mismatched</th>
<th>Matched</th>
<th>Mismatched</th>
</tr>
</thead>
<tbody>
<tr>
<td>ASD</td>
<td>0.78 ± 0.04</td>
<td>0.76 ± 0.05</td>
<td>0.78 ± 0.04</td>
<td>0.76 ± 0.05</td>
</tr>
<tr>
<td>WS</td>
<td>0.78 ± 0.04</td>
<td>0.76 ± 0.05</td>
<td>0.78 ± 0.04</td>
<td>0.76 ± 0.05</td>
</tr>
<tr>
<td>TC</td>
<td>0.78 ± 0.04</td>
<td>0.76 ± 0.05</td>
<td>0.78 ± 0.04</td>
<td>0.76 ± 0.05</td>
</tr>
</tbody>
</table>

N100 peak amplitude (Figs. 1,2,4)

• The amplitude of the N100 of the WS group was significantly smaller than that observed in ASD and TC.

N200 peak amplitude (Figs. 1,2,4)

• The N200 of the ASD group was significantly smaller than that of the TC and WS groups.

• The N200 of the WS group was significantly larger relative to ASD and TC groups.

N320 mean amplitude (250 - 400 ms) (Figs. 3,4)

• TC participants showed an N320 match/mismatch effect only to upright faces.

• Participants with WS showed an N170 match/mismatch effect that was significant for both upright and inverted faces.

• ASD participants showed an N170 match/mismatch effect that was significant for upright and inverted faces.

• ASD participants showed an N170 match/mismatch effect that was significant for both upright and inverted faces.

• N170 peak amplitude

• The N170 was larger to inverted than upright faces across groups, and peaked earlier for individuals with WS (157 ms) than ASD (167 ms) or TC (171 ms).

Conclusions

Consistent with previous ERP studies of face processing in individuals with WS, the present study found evidence for decreased N100 amplitudes in this group, as compared with both ASD and TC. This effect may be linked to structural brain abnormalities, such as those noted in the configuration of gyri and sulci (1,3).

Also consistent with previously reported findings, the N200 was larger in individuals with WS, especially when compared to individuals with ASD. It has been postulated that the larger amplitudes of the N200, as well as increased activation of the anterior cingulate cortex reported in WS, may be indexing heightened attention to faces in this population (2,4). If attention, possibly mediated by social interest, is reflected in the amplitude of the N200, then the N200 amplitudes would be expected to be highest in the WS, and lowest in the ASD group, an effect that was observed in this study (Figs. 1,2,4).

In later processing the WS group showed an N320 match/mismatch effects, suggesting that they processed both upright and inverted faces as though they were upright. In contrast, participants with ASD showed P500 match/mismatch effects (previously observed only to inverted faces in TC) for both upright and inverted faces, suggesting that these individuals processed upright and inverted faces as though they were inverted. The contrasting patterns of brain activation to social (face) stimuli indicate that individuals with ASD and those with WS process faces using qualitatively different brain systems.

References