Biobehavioral Correlates of Autism Spectrum Disorder in Infants with Fragile X Syndrome

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Research Objectives

• Examine neural correlates of face processing in typically developing infants & those at high-risk of ASD
  – Typically developing infants
  – Infant siblings of children with autism
  – Infants with Fragile X Syndrome

• Examine relation between ERP responses & behavioral risk factors
  – ERP: segments of EEG time-locked with an event of interest & averaged across trials
  – Behavioral risk factors: measured by the AOSI
Neural Correlates of Face Processing

- Adults show face specific ERP responses
  - N170
    - Negative peak over posterior scalp regions
    - ~170 ms after stimulus onset
    - Right lateralized
    - Greater amplitude & shorter latency to faces than objects (e.g., Bentin et al., 1996; Eimer, 1998; Rossion et al., 2000)
Neural Correlates of Face Processing in Autism

- Distinct differences in activation to faces in adults with autism spectrum disorders (ASD)
  - N170: longer latency in response to faces than typical controls
- No right hemisphere advantage for faces

McPartland et al., 2004
Neural Correlates of Face Processing in Infancy

• In typically developing infants, two face sensitive ERP components have been found similar to the adult N170 (de Haan et al., 2003; Halit et al., 2003)
  • N290
    – Negative peak over posterior sites, 290-350 ms
    – Greater to faces than visual noise (Halit et al., 2004)
  • P400
    – Positive peak over posterior sites, 390-450 ms
    – Shorter latency to faces than other objects

Johnson et al., 2005
Neural Correlates of Face Processing in Infancy

• Negative central (Nc)
  • Reflects attention and arousal responses (e.g., Reynolds et al., 2010; Richards et al., 2010)
    – Greater in amplitude to novel or salient stimuli
  • Negative component over midline sites
  • Occurs 350-750 ms after stimulus onset
  • Greater to mother’s face than stranger’s face (de Haan & Nelson, 1997, 1999)
Current Study

• Compared face related ERP components in TD, ASIB, and FXS infants
  – Investigated the impact of risk, as indicated by the AOSI, on ERP responses
    • N290
    • P400
    • Nc
  – The first study to examine face-sensitive ERP components in FXS children
Participants

• 12-month-olds
  – 23 typically developing (TD) infants
    • 17 M, 5 F
  – 22 infants siblings of children with autism (ASIB)
    • 19 M, 3 F
  – 18 infants with fragile X syndrome (FXS)
    • 8 M, 10 F
    • 15 full mutation, 3 premutation
Methods

• EEG recording:
  – Used a high-density EGI 128-channel HydroCel Geodesic Sensor Net
  – Recorded 124 channels of EEG, 2 channels of EOG, & 2 channels of ECG

• Procedure:
  – Infants passively viewed a series of brief stimulus presentations (500 ms)
    • Mother’s face
    • Unfamiliar female’s face
    • Own toy
    • Unfamiliar toy
Methods

- **N290 ERP analysis:**
  - Used individualized time windows to capture each subject’s peak N290

- **P400 ERP analysis:**
  - Mean amplitude from 350-450 ms post-stimulus onset

- **Nc ERP analysis:**
  - Mean amplitude from 350-700 ms post-stimulus onset
N290 Results

- Larger amplitude response to faces compared with toys
  - Main effect of trial type, $F(1,88)=4.96; p < .01$
- No differences in amplitude across the 3 groups
## N290 Results

<table>
<thead>
<tr>
<th></th>
<th>TDD</th>
<th>ASIB</th>
<th>FXS</th>
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<tbody>
<tr>
<td>Faces</td>
<td><img src="image1" alt="TDD Faces" /></td>
<td><img src="image2" alt="ASIB Faces" /></td>
<td><img src="image3" alt="FXS Faces" /></td>
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<tr>
<td>Toys</td>
<td><img src="image4" alt="TDD Toys" /></td>
<td><img src="image5" alt="ASIB Toys" /></td>
<td><img src="image6" alt="FXS Toys" /></td>
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Mean ERP from 300-400 ms after stimulus onset
P400 Results

- TD: equal amplitude to faces & toys
- ASIB & FXS: greater amplitude to toys compared with faces
  - Main effect of stimulus type, $F(1, 33) = 8.27, p < .01$
  - Marginally significant interaction of group and stimulus type, $F(2, 33) = 2.79, p < .08$
Nc Results

- Faces vs. Toys
  - Slightly greater amplitude to faces than toys
- Mother’s Face vs. Stranger’s Face

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<thead>
<tr>
<th></th>
<th>TD</th>
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<th>FXS</th>
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<tr>
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<td><img src="path/to/image" alt="Image" /></td>
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<td>Stranger</td>
<td><img src="path/to/image" alt="Image" /></td>
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Mean ERP from 300-700 ms after stimulus onset
Neural Correlates of Risk for Autism Outcome in ASIB and FXS Groups

• All infants completed the AOSI
  – Results were examined based on the AOSI total score
  – Infants with a total score of less than 7 were labeled lower risk, while those with at least a score of 7 were labeled higher risk

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<tbody>
<tr>
<td>High-risk (AOSI markers ≥ 7)</td>
<td>N=0</td>
<td>N=7</td>
<td>N=8</td>
</tr>
<tr>
<td>Low-risk (AOSI markers &lt; 7)</td>
<td>N=21</td>
<td>N=12</td>
<td>N=8</td>
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### Nc & AOSI Results

<table>
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<th>TD</th>
<th>Low-AOSI ASIB</th>
<th>High-AOSI ASIB</th>
<th>Low-AOSI FXS</th>
<th>High-AOSI FXS</th>
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<td>Mother</td>
<td><img src="image1.png" alt="Image" /></td>
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<td><img src="image5.png" alt="Image" /></td>
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<tr>
<td>Stranger</td>
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Mean ERP from 300-700 ms after stimulus onset
Conclusions

- **N290**
  - Greater amplitude response to faces than toys in all three groups
  - The lack of an interaction may indicate that this early component reflects automatic face processing/recognition and is not strongly influenced by risk factors

- **P400**
  - Different pattern of responses in TD compared with ASIB & FXS groups
    - TD: equal response to faces & toys
    - ASIB & FXS: greater amplitude to toys compared with faces
  - Differences between TD and at-risk infants may reflect an object-based preference for processing occurring during this time window

- **Nc**
  - Faces vs. toys
    - Slightly greater amplitude to faces than toys in all groups
  - Mother vs. stranger
    - Greater to mother’s face in TD & ASIB groups, but not FXS
    - Interacted with AOSI scores, FXS infants with high AOSI showed greater amplitude to the stranger’s face
  - The relationship between group status and risk status with Nc responses may reflect differences in attention and cognitive processing of familiar and novel faces
Acknowledgements
Questions or Suggestions?