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

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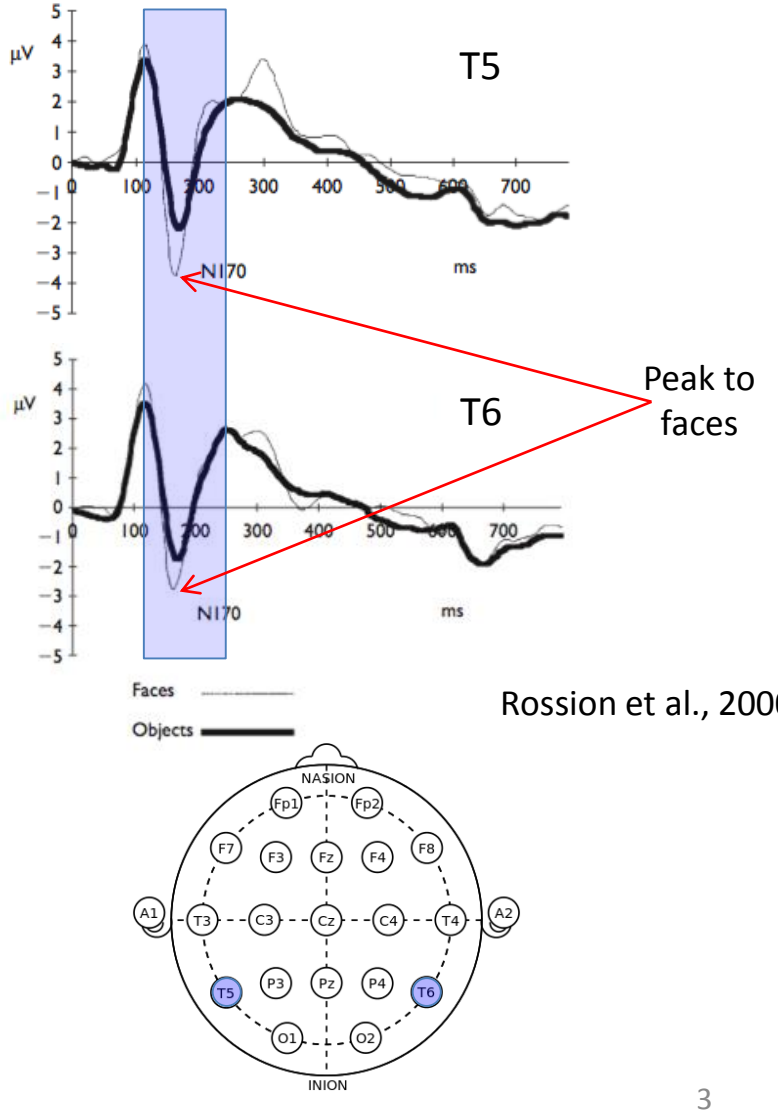
Research Objectives

- 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

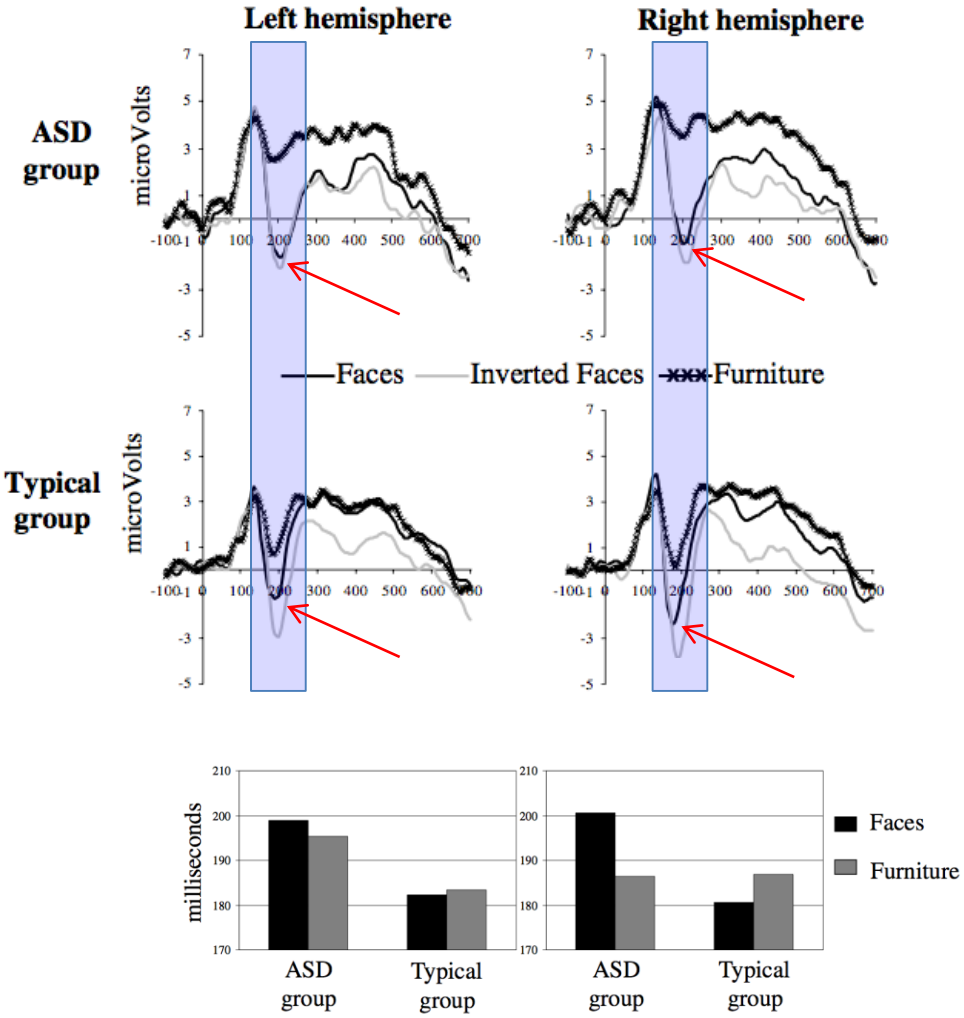
- Adults show face specific ERP responses
- N170
  - Negative peak over posterior scalp regions
  - ~170 ms after stimulus onset
  - Right lateralized
  - Greater amplitude & shorter latency to faces than objects
    (e.g., Bentin et al., 1996; Eimer, 1998; Rossion et al., 2000)



Rossion et al., 2000

Neural Correlates of Face Processing in Autism

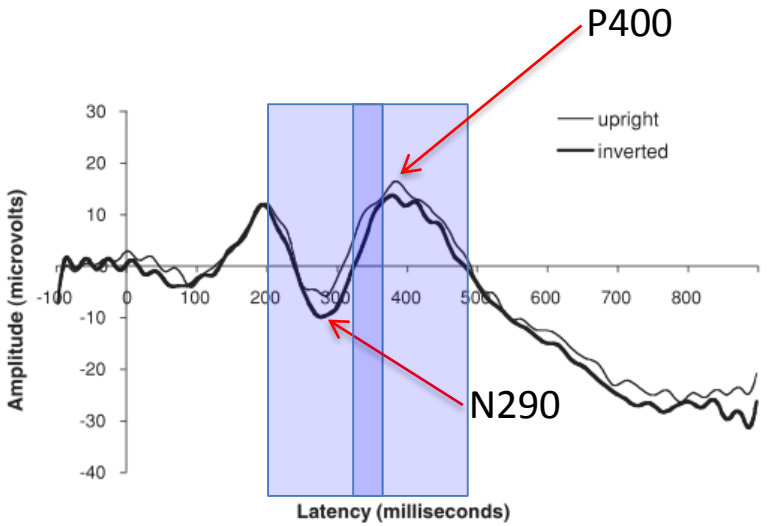
- Distinct differences in activation to faces in adults with autism spectrum disorders (ASD)
  - N170: longer latency in response to faces than typical controls
    - No right hemisphere advantage for faces



McPartland et al., 2004

Neural Correlates of Face Processing in Infancy

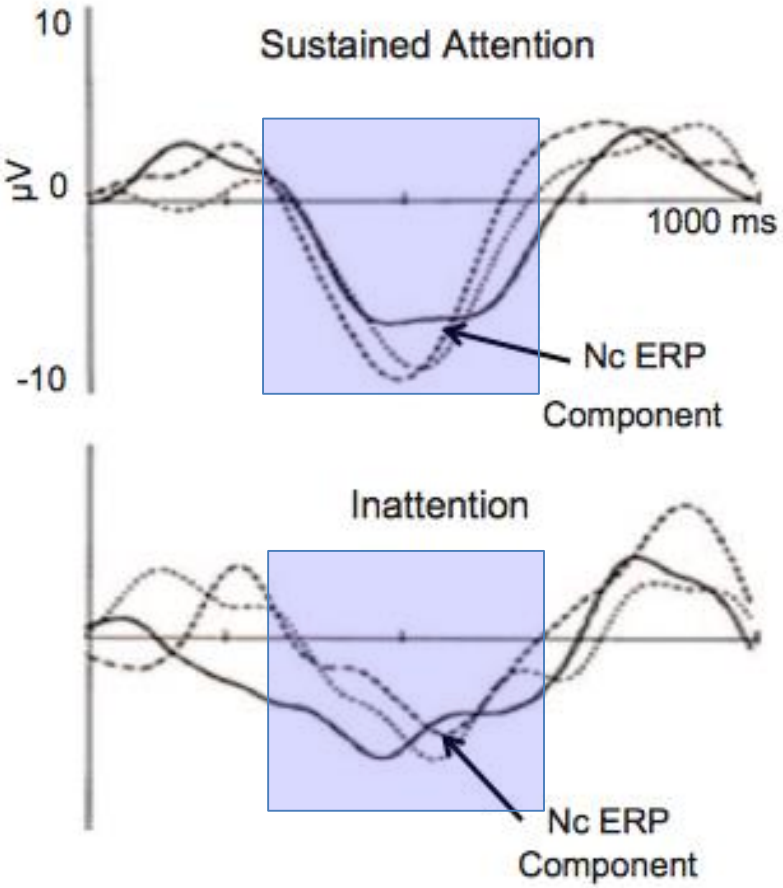
- In typically developing infants, two face sensitive ERP components have been found similar to the adult N170 (de Haan et al., 2003; Halit et al., 2003)
  - N290
    - Negative peak over posterior sites, 290-350 ms
    - Greater to faces than visual noise (Halit et al., 2004)
  - P400
    - Positive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



Richards et al., 2010

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

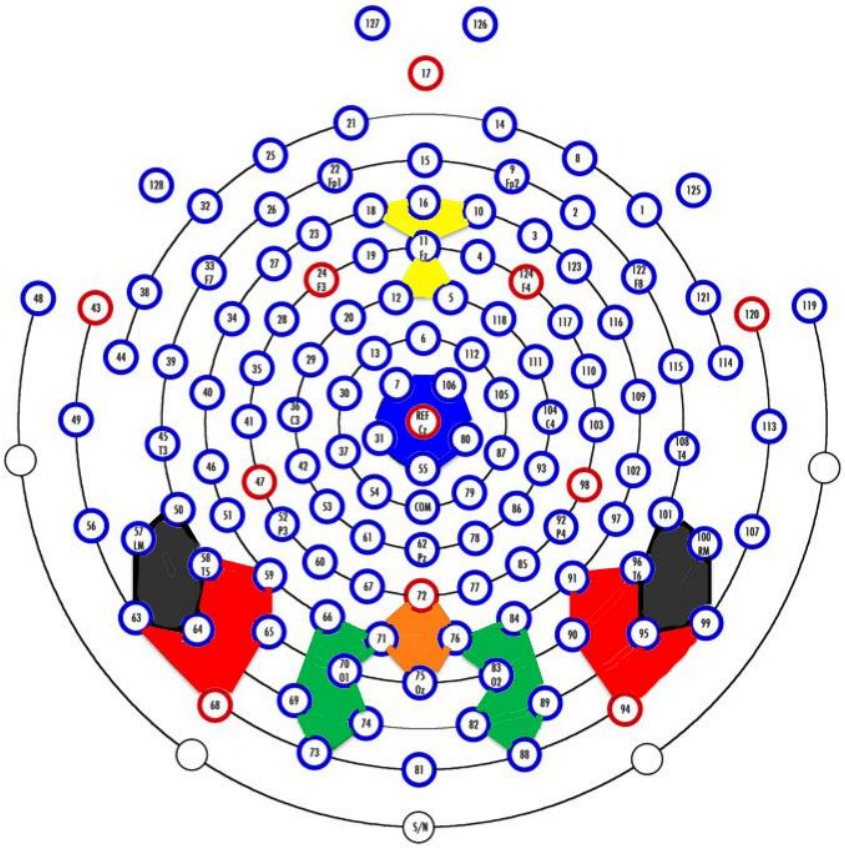
- 12-month-olds
  - 23 typically developing (TD) infants
    - 17 M, 5 F
  - 22 infants siblings of children with autism (ASIB)
    - 19 M, 3 F
  - 18 infants with fragile X syndrome (FXS)
    - 8 M, 10 F
    - 15 full mutation, 3 premutation

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

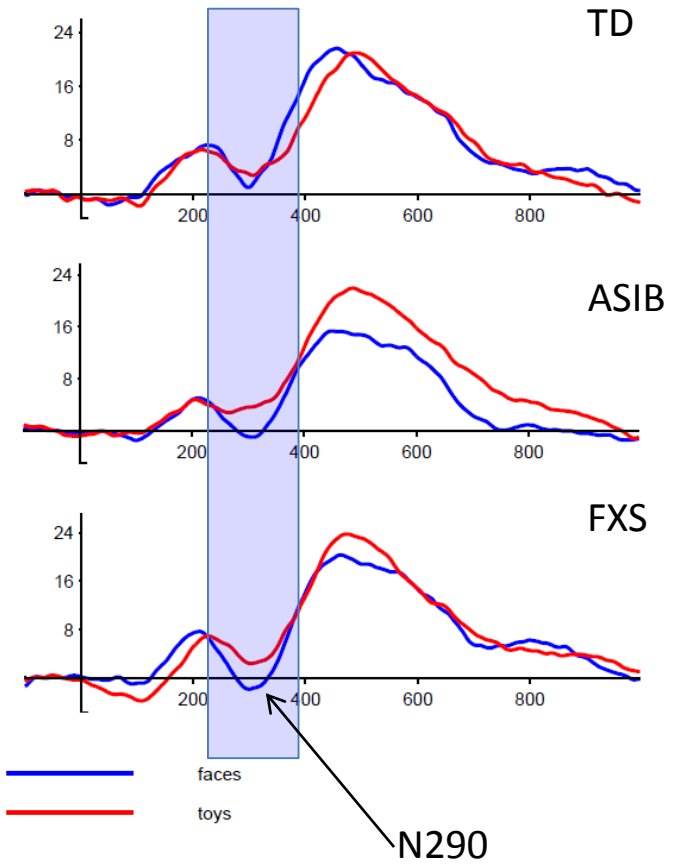
Methods

- 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

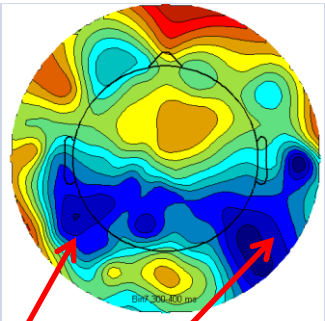
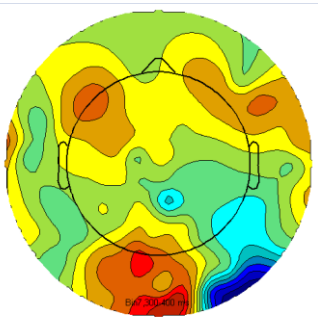
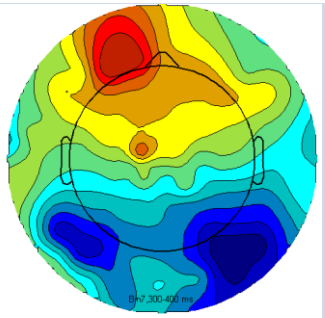
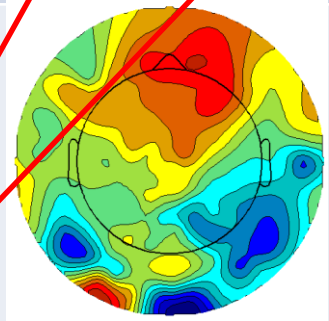
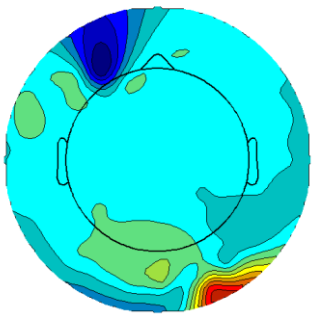
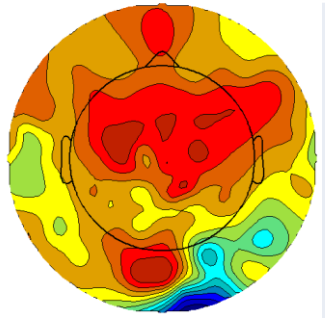


N290 Results

- 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

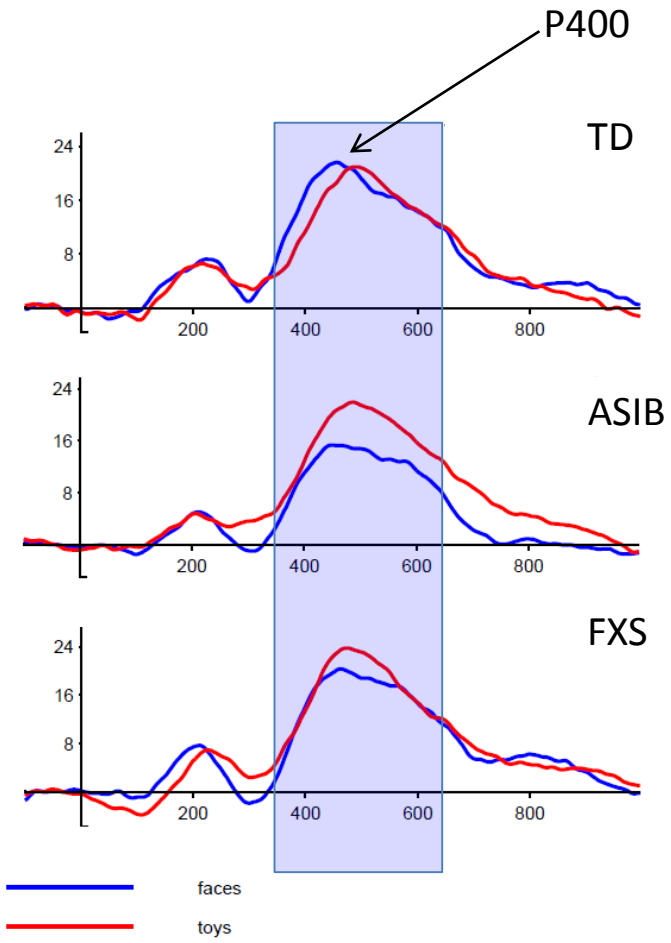
	TDD	ASIB	FXS
Faces			
Toys			

N290

Mean ERP from 300-400 ms after stimulus onset

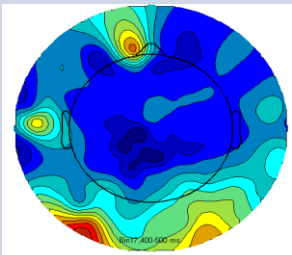
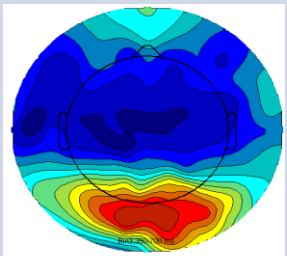
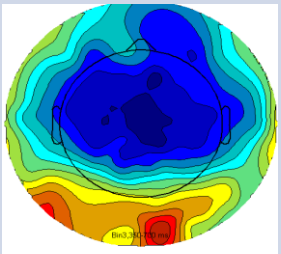
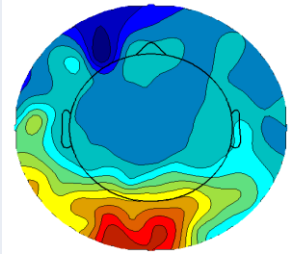
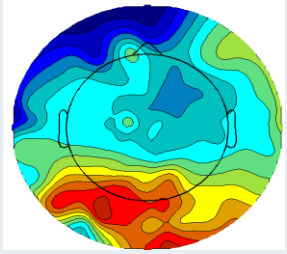
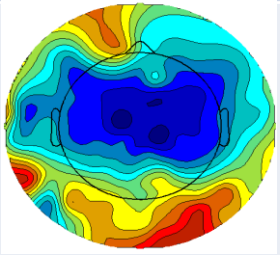
P400 Results

- 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

	TD	ASIB	FXS
Mother			
Stranger			

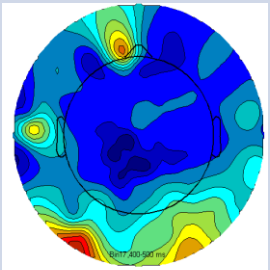
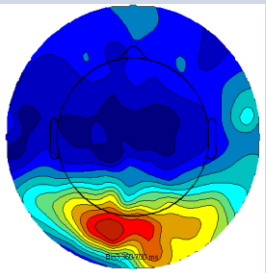
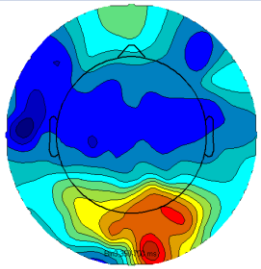
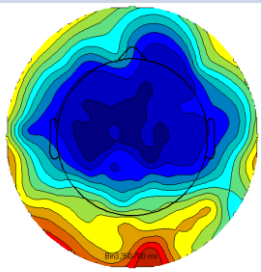
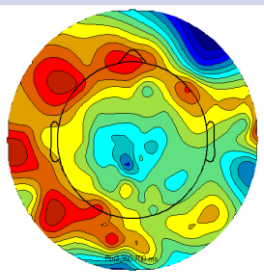
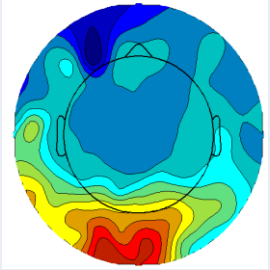
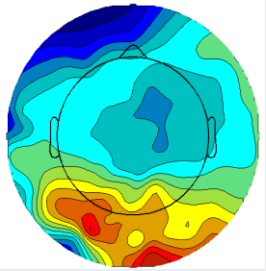
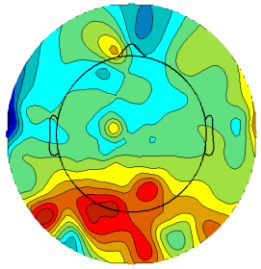
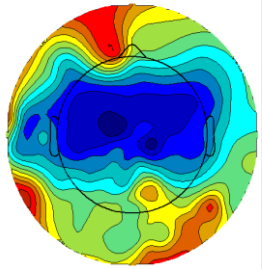
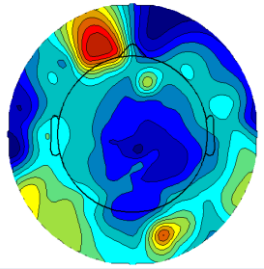
Mean ERP from 300-700 ms after stimulus onset

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

	TD	ASIB	FXS
High-risk (AOSI markers ≥ 7)	N=0	N=7	N=8
Low-risk (AOSI markers < 7)	N=21	N=12	N=8

Nc & AOSI Results

	TD	Low-AOSI ASIB	High-AOSI ASIB	Low-AOSI FXS	High-AOSI FXS
Mother					
Stranger					

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?