Neural Correlates of Face Processing in Typically Developing Infants and Infants at Risk for Autism and Infants with Fragile X Syndrome

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Nicole Zieber, John E. Richards, Bridgette Tonnsen, Jane E. Roberts

INTRODUCTION

Distinct differences in the neural activation to faces have been documented in adults with autism spectrum disorders (ASD). Specifically, this group exhibits significantly longer latencies of the N170 component (a right-lateralized ERP component over lateral posterior regions of the scalp occurring 170ms after stimulus onset) in response to faces than those exhibited by typical controls. Adults with ASD also fail to demonstrate a right hemisphere advantage for faces. In typically developing infants, two ERP components (N290, P400) have been found to be modulated by faces in a similar manner to the adult N170. Yet little research has examined whether this is the case in infants at high risk for developing autism spectrum disorders, and even fewer studies have compared face processing in ASIBs to other groups at high genetic risk for autism, such as infants with fragile X syndrome (the leading known heritable cause of autism). The current study sought to compare early differences in face perception between typically developing (TD) infants, high-risk infant siblings of children with ASD (ASIBS), and infants with Fragile X (FX) syndrome through the recording of event-related potentials (ERPs) to objects and faces at 12 months of age.

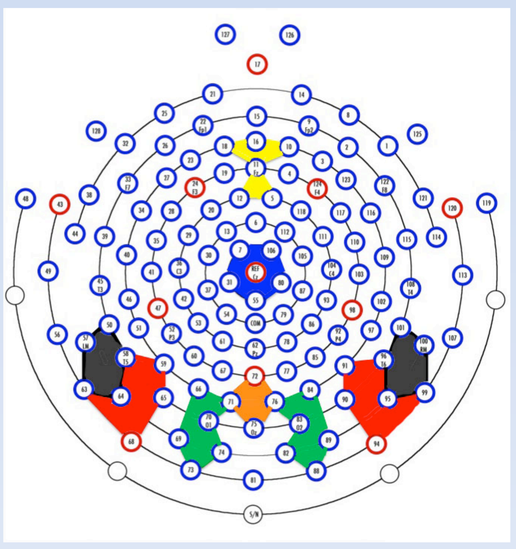
Pictures were taken of the infant's mother and infant's favorite toy when they arrived for the study.

Participants:
Tested at 12 months, 20-Typically-Developing infants, 17 infant siblings of children with ASD (ASIB), and 17 infants with FXS (3 premutation, 14 FXS).

Stimuli: Images of: infant's own mother, another infant's mother, infant's own toy, another infant's toy

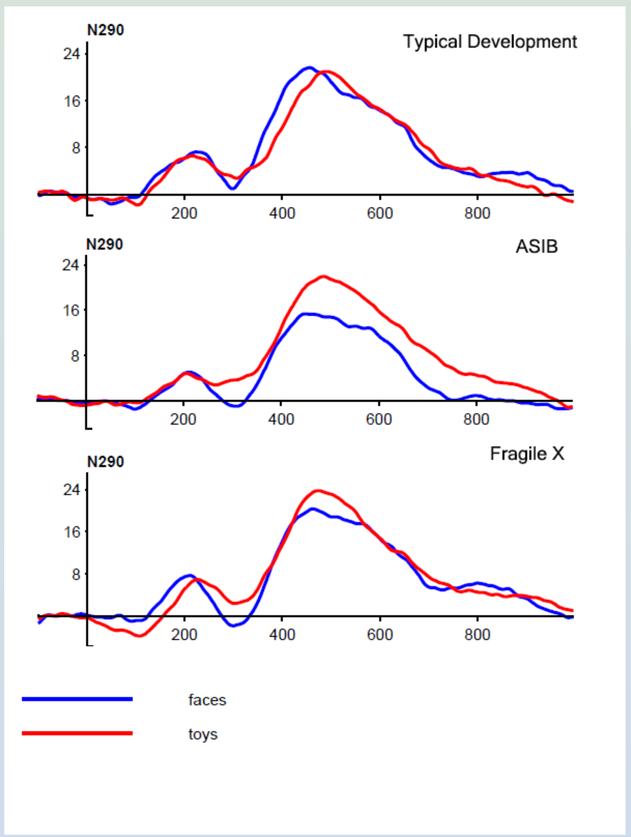
Procedure:

- Infants passively viewed a series of brief stimulus presentations (500 ms) of the images randomly interspersed across trials.
- High-density EEGs were recorded using an EGI 128-channel Geodesic Sensor Net.
- EEG data was analyzed for groups of electrodes over occipito-temporal regions (e.g., around T5, T6, O1, O2, Oz) based upon previous infant studies (de Haan et al., 2002).
- For each participant, ERP grand averages were computed for the time of the target onset, and the peak amplitude was derived using individualized time windows to capture each subject's N290; done with 1 hz high-pass filter.
- The Nc was calculated from 350 to 700 ms post-stimulus onset



RESULTS: N290 and P400 to Faces and Toys

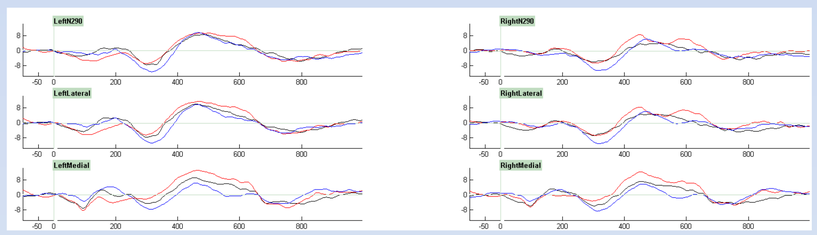
The dependent measure was the mean amplitude of the N290 component. There was a main effect of trial type [$F(1,88)=4.96$; $p < .01$]), as the amplitude was larger for faces than for toys, but no main effects or interactions of the group factor.. Thus, the N290 amplitude was larger for faces than for toys but not different for the three groups. Using the mean amplitude of the P400 as the dependent measure, an ANOVA was conducted with group (TD, ASIB, FX) entered as a between subjects factor and stimulus category (face, toy) entered as a repeated factor. This revealed a significant main effect of stimulus category [$F(1, 33) = 8.27$, $p < .01$] and a marginally significant interaction between group and stimulus category [$F(2, 33) = 2.79$, $p < .08$]. The P400 amplitude was the same for face and toys for the TDD group, but significantly larger for the toy stimuli than the face stimuli for the SASD and FXS groups.



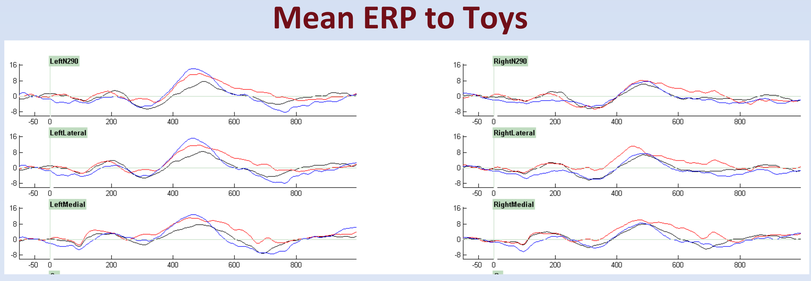
Spatial distribution of ERP to faces and toys over age

The response to faces and toys was similar for the three groups However, there were some differences in the distributions over the head. The TDD and FXS infants had a similar left-side-ehancement of the N290 to the faces over the toys, with an overall right N290 laterality for faces. However, the ASIB group had predominantly a right-lateralized N290 for the faces. The enhancement of the P400 for toys for the ASIB and FXS groups occurred predominantly over the left scap areas. (TDD, ASIB, FXS are black, red, and blue, respectively).

Mean ERP to Faces



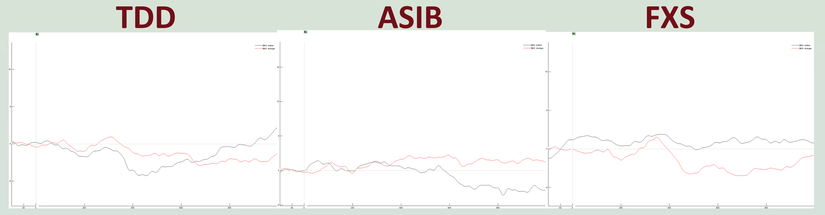
Mean ERP to Toys



The Nc component is a negative ERP component occurring over the frontal-central scalp regions (e.g., "Negative Central"). It is related to infant attention and is likely the first component reflecting the arousal mechanisms in the brain. The response to faces and toys were similar for the Nc for all three groups; there was a slightly larger response to the faces than the toys. There was a clear increase in the Nc component repsonse to the mothers face over the strangers face for the TDD and ASIB groups, but not the FXS group.

Mean ERP for the Nc electrodes

TDD ASIB FXS

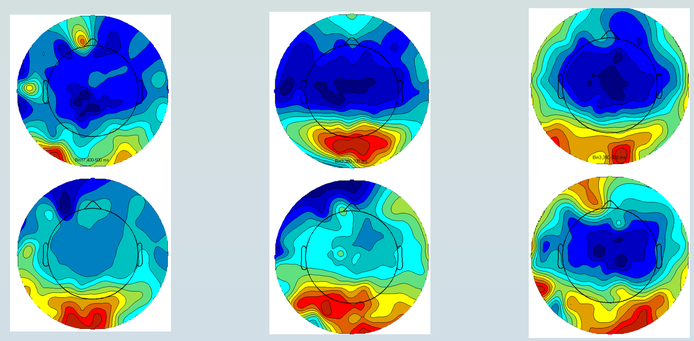


Mean ERP from 300 to 700 ms post-onset

TDD ASIB FXS

Mother

Stranger



Risk for Autism Outcome in ASIB and FXS Groups

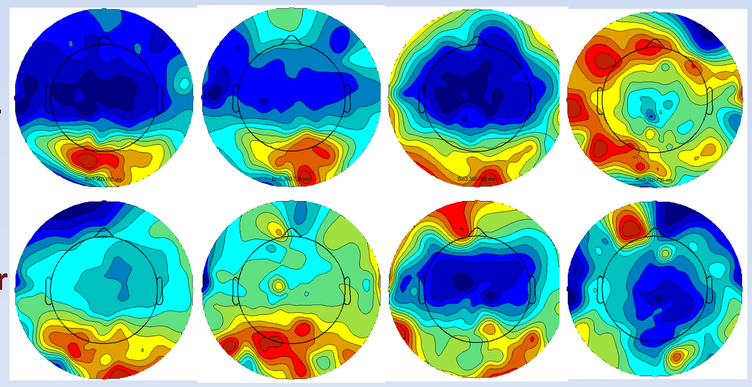
The Autism Observation Scale for Infants (AOSI) is a diagnostic scale that assesses early signs of autism as they emerge in infants at risk for autism (e.g., infant siblings of older child with ASD diagnosis). The ASIB group all had AOSI "number of markers" < 7, whereas 5 of the FXS infants had greater than 7 numbers of risk markers. We split the ASIB group based on its AOSI total score of < > 7, and the FXS group on the same AOSI score (which was concordant with the no of markers). The ASIB group for both low and high scores showed a larger Nc to the mother than the stranger, whereas the low-risk FXS group looked like the TDD and ASIB groups, whereas the high-risk group had larger Nc to the stranger..

Mean ERP from 300 to 700 ms post-onset

Lo – ASIB Hi-ASIB Lo-FXS Hi-FXS

Mother

Stranger

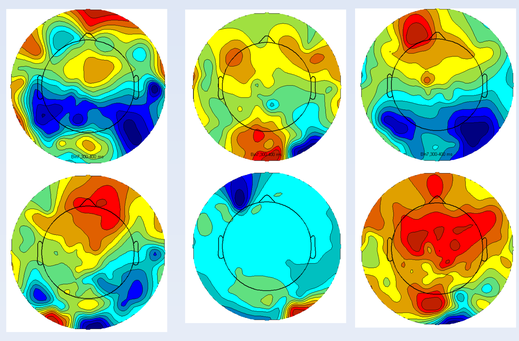


Mean ERP from 300 to 400 ms post-onset

TDD ASIB FXS

Faces

Toys



CONCLUSIONS

The current study is the first to compare face-sensitive ERP components in FXS children. As a group these children are at high-risk for ASD outcome. We found the N290 component to be similar in typically developing, children with an older sibling diagnosed with ASD, and children with FXS/premutations. There were some laterality differences in the three groups, with the TDD infants showing a left face/toy distinction, and theother groups showing smaller laterality effects. The P400 seemed to be larger in the two at-risk groups. This may relflect an object-based preference for processing occurring at the P400 latencies. A compelling finding was that FXS children assessed at 12 months with the AOSI as showing multiple risk signs showed a larger Nc to the stranger than to the mother face, whereas both TDD and ASIB groups showed enhanced Nc response to the mother face. This could mean the early component (N290) more automatic components might not be strongly influenced by the risk factors, whereas the later component is response to processes of attention and cognitive processing.