ERP Correlates of Emotion Processing in Adults with Autism and Schizophrenia

Emily Levy, Adam Naples, Jennifer Foss-Feig, Rachael Tillman, Hannah Reuman, Karen Law, Hannah Samson, Caroline Diehl, Charles Schleifer, Nicole Santamauro, Alan Anticevic, Vinod Srihari & James McPartland

McPartland Lab, Yale Child Study Center, New Haven, CT

Background

Autism Spectrum Disorder (ASD) and Schizophrenia (SZ) are neurodevelopmental disorders characterized by difficulties with social cognition, such as eye contact, emotion recognition, and theory of mind.[1,2] Prior electrophysiological studies suggest atypical structural encoding of faces, as indexed by N170 amplitude and latency,[3] and emotional processing, as indexed by P300 amplitude,[4] in both clinical groups compared to typically developing (TD) adults. Despite parallel findings in separate literatures, no studies have directly compared electrophysiological correlates of emotion processing in individuals with ASD, SZ, and TD.

The current study investigated N170 and P300 ERP response to happy and fearful faces in adults with ASD, SZ, and TD and relates them to behavioral measures of emotion identification. By integrating eye-tracking, we developed a gaze-contingent ERP paradigm to study emotion processing in the context of interactive faces that respond to participant gaze.

We predicted that: 1) In response to gaze-contingent shifts in facial displays of emotion, adults with ASD and SZ would show attenuated and delayed right-hemisphere N170 and smaller P300 amplitude compared to TD adults, and 2) Behavioral measures of emotion recognition would correlate with strength of N170 and P300 responses.

Method

Participants

- 42 adults aged 18-48 completed EEG, questionnaires, and neuropsychological assessments.
- Groups were matched on FSIQ, age, and sex.

	N (F)	Age (SD)	FSIQ (SD)
TD	16 (3F)	26.5 (7.2)	109.7 (21.5)
ASD	12 (2F)	23.7 (5.4)	103.8 (17.5)
SZ	14 (1F)	30.5 (8.6)	96.1 (12.0)

Data Collection and Processing

- Behavioral measures of SZ and ASD symptomatology and emotion recognition collected during visit: Autism Diagnostic Observation Schedule (ADOS), Positive and Negative Syndrome Scale (PANSS), and Reading the Mind in the Eyes Test (RMET).
- EEG data were recorded with 128-channel HydroCel Geodesic Sensor Nets at 1000Hz. Eye-tracking data were recorded concurrently with EEG using SR-Eyelink at 500Hz. Ocular artifact was removed from EEG data with independent component analysis.
- ERP waveforms were segmented to emotion onset. N170 latency and mean amplitude were extracted from electrode groups over the left and right hemisphere. P300 mean amplitude was extracted from midline parietal electrodes.
- Amplitude and latency were analyzed with Repeated Measures ANOVAs (within-subject factors: Emotion, Hemisphere; between-subject factor: Group). Follow-up analyses were performed to explore direction of interactions.

References

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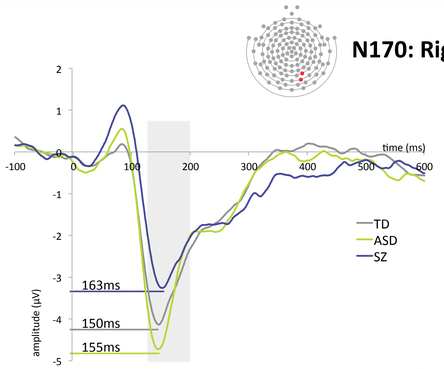
3. Bentin, S., Allison, T., Puce, A., Perez, E., & McCarthy, G. (1996). *Electrophysiological studies of face perception in humans*. J Cognitive Neurosci, 8(6): 551-565.
4. Kestenbaum, R. (1991). *Neural and behavioral correlates of emotion recognition in children and adults*. J Exp Child Psychol, 54(1): 1-18.

Method

Experimental Paradigm

- A gaze-contingent EEG paradigm was used to measure emotion processing. Upon participant fixation to the eyes of a neutral face, it displayed an emotional expression (happy or fearful).
- With this design, participants were fixating on the eyes of the emotional face when it appeared onscreen.

Preliminary Results



Amplitude

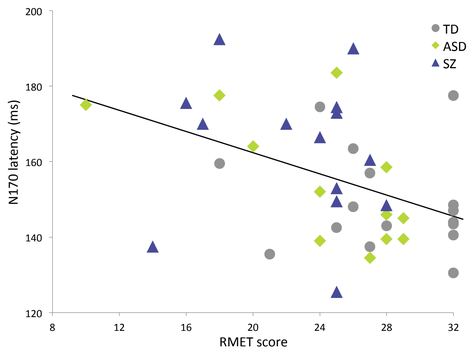
- No significant effects or interactions in the right hemisphere.

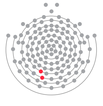
Latency

- Main effect of Group: In the right hemisphere, the SZ group showed a marginally delayed N170 response compared to the TD group.
  - $F(2,39) = 2.667$, $p = .081$

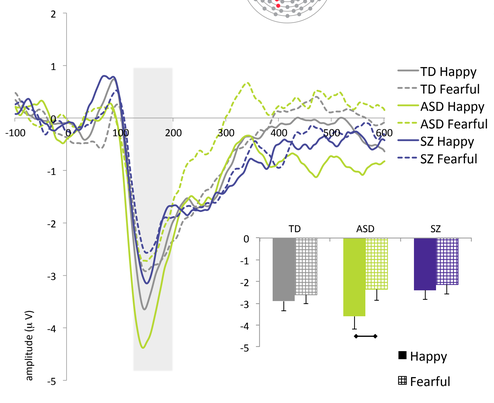
Correlations

- Across groups, N170 amplitude and latency over the right hemisphere correlated with RMET score, such that a faster and more negative N170 was associated with better emotion identification.
  - Latency: $r = -.410$, $p = .007$
  - Amplitude: $r = -.324$, $p = .038$





N170: Left Hemisphere



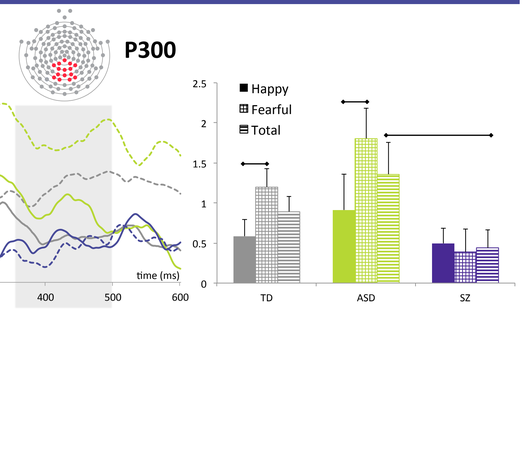
Amplitude

- Main effect of Emotion: Across groups, fearful faces elicited a less negative N170 response than happy faces.
  - $F(2,39) = 20.325$, $p < .0005$
- Group by Emotion interaction: In the ASD group, fearful faces elicited a less negative N170 than happy faces; there were no differences by emotion in the TD or SZ groups.
  - $F(2,39) = 5.490$, $p = .008$

Latency

- Main effect of Emotion: Across groups, happy faces elicited a faster N170 than fearful faces.
  - $F(2,39) = 5.040$, $p = .031$

Preliminary Results



Amplitude

- Group by Emotion interaction: Fearful faces elicited more robust P300 responses than happy faces in the ASD and TD groups. There was no modulation by emotion in the SZ group.
  - $F(2,39) = 4.948$, $p = .012$
- Main effect of Group: Across emotions, P300 amplitude was marginally attenuated in the SZ group, particularly relative to the ASD group.
  - $F(2,39) = 2.733$, $p = .077$

Conclusions

Summary of Findings

- A gaze-contingent face processing paradigm revealed distinct neural responses to interactive happy and fearful emotional expressions.
- Over left hemisphere, participants with ASD showed modulation of N170 amplitude by emotion, such that fearful faces elicited an attenuated response relative to happy faces.
- Face and emotion processing deficits were observed in the SZ group relative to the TD group, as indexed by:
  - Delayed right-hemisphere N170 across emotions.
  - No modulation of P300 amplitude by emotion.
- Correlations between emotion identification and N170 amplitude and latency suggested a relationship between behavior and neural response spanning diagnoses.

Interpretations and Future Directions

- Due to the gaze-contingent nature of the current paradigm, participants were forced to make eye contact with the stimuli. Because individuals with ASD tend to make less eye contact, these stimuli may be especially salient for them, resulting in a heightened neural response relative to passive experimental paradigms.
- Future research will continue to identify diagnostic convergence and divergence, as indexed by behavioral, eye-tracking, and ERP measures. The ultimate goal of this work is to identify biomarkers of social performance to enable targeted treatments based on social function and dysfunction rather than diagnostic category.

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