Reduced Emotion-Specific Neural Response to Faces Relates to Impaired Emotion Recognition in Adults with Autism and Typical Development

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Background

- Autism spectrum disorder (ASD) is a neurodevelopmental disorder characterized by difficulties in social communication
- Difficulty interpreting emotional faces is a characteristic of ASD influencing day-to-day social interactions, making it important to identify its neural correlates
- The Reading the Mind in the Eyes Test (RMET) assesses ability to infer mental and emotional states of others
- Past studies have identified delayed latency of N170, a face-sensitive event related potential (ERP), in individuals with ASD compared to individuals with typical development (TD) (McPartland *et al.*, 2004)
- There is a lack of research examining emotion-specific variance in N170 latency and how this variance may contribute to common ASD symptomatology, specifically impaired emotion recognition

OBJECTIVE

- To investigate how neural response to emotional faces relates to emotion recognition in individuals with and without ASD

Methods

PARTICIPANT DEMOGRAPHICS

Clinical Diagnosis	N	Sex (M,F)	Mean Age (Range)	Mean WASI-II (Range)
TD	49	28, 21	26.63 (18-46)	112.64 (72-142)
ASD	30	23, 7	24.14 (18-38)	105.23 (70-142)
DNM	12	9, 3	24.94 (18-40)	102.25 (77-120)

Table 1. Participant demographic data. DNM did not meet traditional research standards of ASD. Diagnostic groups did not differ significantly in age or IQ (p>.05)

BEHAVIORAL DATA

- ASD diagnoses were confirmed via the Autism Diagnostic Observation Schedule (ADOS-2) and clinician endorsement of DSM-5 criteria for ASD
- Ability to understand the emotional state of others was assessed with the RMET

TRIAL STRUCTURE

- Crosshair followed by a static face with a neutral expression
- Face changed expression from neutral to happy or fearful after 500 ms of fixation (Figure 1)

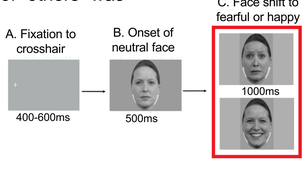

Figure 1. Experimental paradigm & trial structure. ERP data segmented to the emotional face (red box)

Methods

EEG DATA ACQUISITION AND COLLECTION

- EEG collected using a 128-channel HydroCel Geodesic Sensor Net
- Recorded at 1000 Hz

ERP ANALYSIS

- ERP data segmented from -100 ms to 500 ms relative to onset of emotional face
- Data was averaged across selected occipitotemporal electrodes (Figure 2)

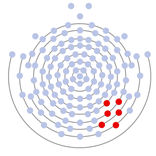

Figure 2. N170 electrode recording sites

STATISTICAL ANALYSIS

- Data was combined across diagnostic groups to increase the variance of RMET scores in the sample; the goal was to look at a range of RMET scores independent of diagnosis in an RDoC (Research Domain Criteria) framework
- N170 latency was submitted to a 2 (condition: fearful, happy) x RMET score (continuous) general linear model
- RMET scores were Z-transformed into a continuous variable
  - We compared high performers to low performers, where high performers scored 1 standard deviation above the mean, while low performers scored 1 standard deviation below the mean

Results

- RMET raw scores across diagnostic groups ranged from 11 to 34 (M=26.54, SD=4.83; Figure 3)

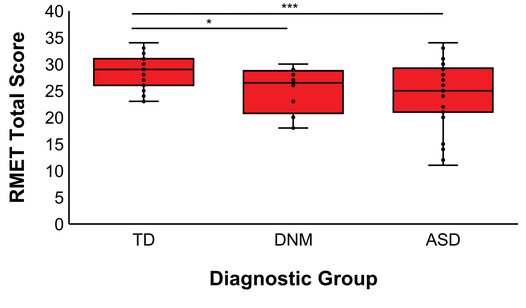

Figure 3. Plot of RMET scores depicting total RMET scores for participants in the ASD, TD, and DNM groups significantly differing (*p<.05, ***p<.001)

Results

- Analyses revealed a main effect of condition on N170 latency [F(1,89)=9.83, p=.002]
- Happy faces (M=174.99, SE=2.43) elicited shorter N170 latencies than fearful faces (M=179.99, SE=2.44; Figure 4)
- Based on the model, differentiation between happy and fearful faces in N170 latency varied depending on extreme RMET performance (Figure 5)
  - High RMET performers (+1 SD) differentiated between happy (M=170.89, SE=3.44) and fearful faces (M=178.50, SE=3.46) in N170 latency (p=.001)
  - Low RMET performers (-1 SD) did not differentiate between happy (M=179.09, SE=3.44) and fearful faces (M=181.48, SE=3.46) in N170 latency (p=.294)

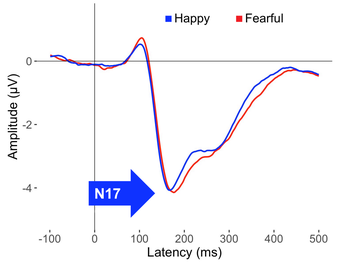

Figure 4. N170 latency in response to presentation of happy or fearful faces across all participants

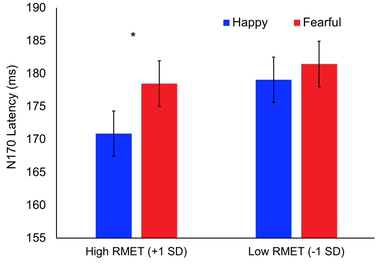

Figure 5. Significant difference between N170 latency to happy and fearful faces for high RMET but not low RMET performers; lines indicate standard error (*p=.001)

Conclusions

- These results suggest that high RMET performance is associated with neural discrimination between fearful and happy faces, as evidenced by differences in N170 latency between emotions; low RMET performance is associated with similar N170 latency for fearful and happy faces
- These data indicate that differences in N170 latency between happy and fearful faces may help to identify adults with autism who have difficulty recognizing emotions
- Future research should examine variance in N170 latency to different emotions before and after interventions that aim to improve emotion recognition skills to determine whether emotion-specific N170 latency may be an effective biomarker for specific treatments

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Reference:
McPartland J., et. al (2004). Event-related brain potentials reveal anomalies in temporal processing of faces in autism spectrum disorder. *J Child Psychol Psychiatry.* 2004 Oct;45(7):1235-45.