Neural response to dynamic and static faces in adults with autism spectrum disorder and typical development

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Background

- Autism spectrum disorder (ASD) is characterized by difficulties in social interaction.
- Electroencephalography (EEG) can be used to study social perception, with the N170 event-related potential (ERP) marking face-sensitive processing.
- Adults with ASD have slower N170 latencies in response to static social stimuli (McPartland et al., 2004).
- While dynamic social stimuli provide a more ecologically valid means of assessing social perception, no study has directly compared neural response to dynamic and static social stimuli in ASD and typical development (TD).
- The objective of this study was to identify differences in neural processing of **dynamic faces and static faces** in individuals with **ASD and TD**.

Method

Participants

DX	*n*	*n* male	Mean Age (Range)	Mean nonverbal IQ (Range)
ASD	16	14	24.1 (18-35)	102 (74-123)
TD	25	14	26.3 (18-39)	113 (85-134)

- Diagnostic groups did not significantly differ in age or nonverbal IQ (*ps*>0.05).

EEG and Eye-tracking Data Acquisition:

- EEG was recorded at 250 Hz (static paradigm) or 1000 Hz (dynamic paradigm) with a 128-channel Hydrocel Geodesic Sensor net.
- Eye-tracking data were collected using an Eyelink-1000 remote camera system for the dynamic faces paradigm.

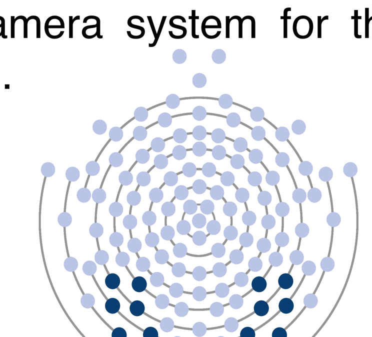


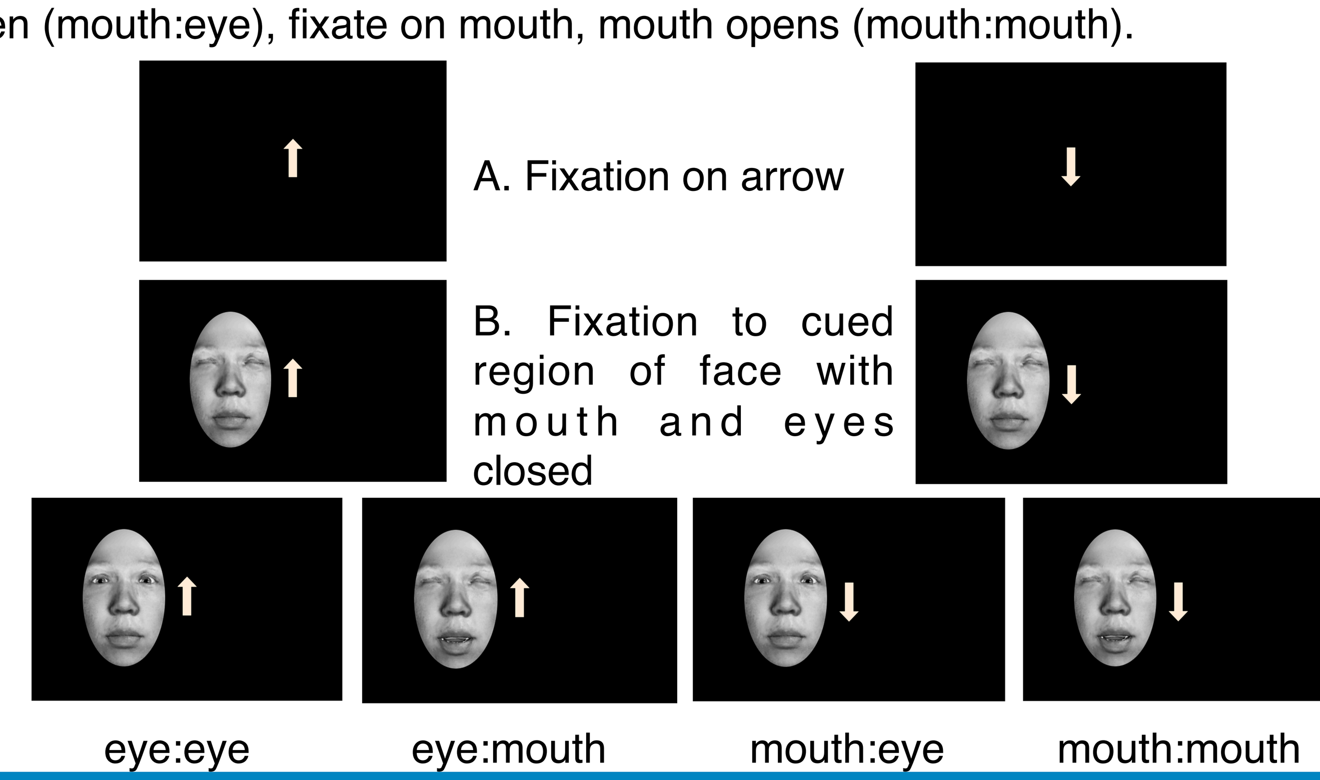
Figure 1. Selection of electrodes for analysis.

ERP Analysis

- N170 (120-270ms) ERPs were extracted from electrodes over left and right occipitotemporal regions (electrodes 58, 64, 68, 59, 65, 69, and electrodes 89, 90, 91, 94, 95, 96 respectively, see Fig. 1). Data were filtered at 0.1 to 30Hz and segmented from -100 to 500ms.
- For the dynamic face paradigm, ERPs were segmented relative to the eyes or mouth opening. For the static face paradigm, ERPs were segmented relative to the appearance of the face.
- Peak latency was analyzed in repeated measures ANOVAs (with diagnostic group as a between-subject factor and face condition and hemisphere as within-subject factors) for each paradigm.

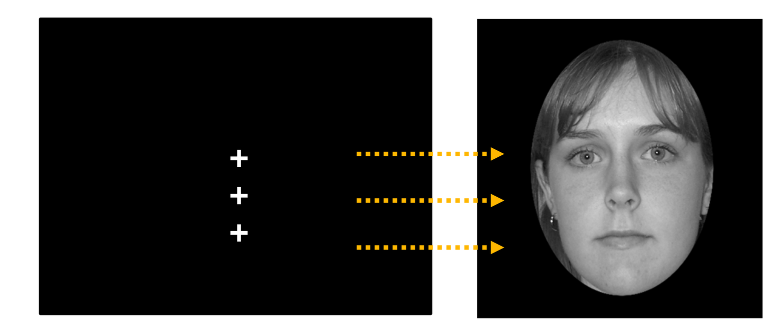
Dynamic Faces Paradigm

- Up or down arrows (A) cued participants to look at the eyes or mouth of a subsequently appearing face (B).
- In response to participant gaze to cued region, the mouth or eyes of the face opened, resulting in 4 conditions: fixate on eyes, eyes open (eye:eye), fixate on eyes, mouth opens (eye:mouth), fixate on mouth, eyes open (mouth:eye), fixate on mouth, mouth opens (mouth:mouth).

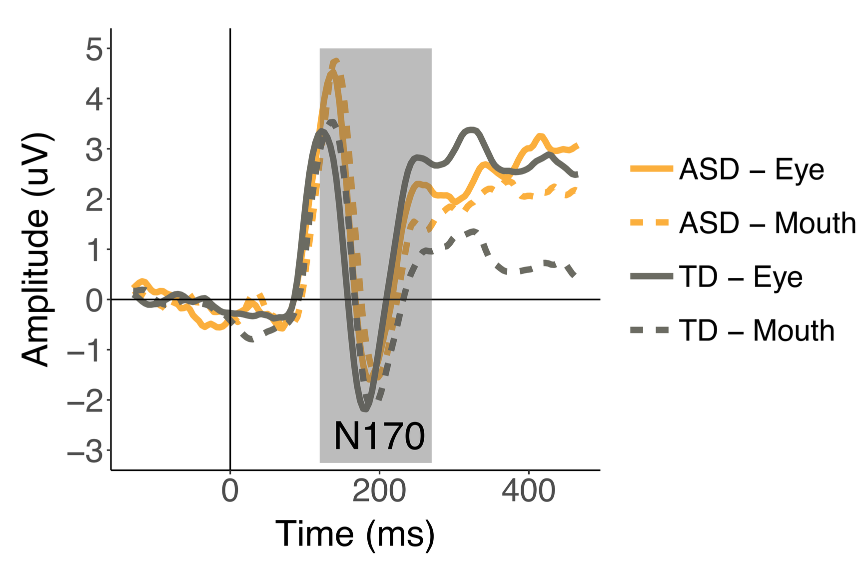


Static Faces Paradigm

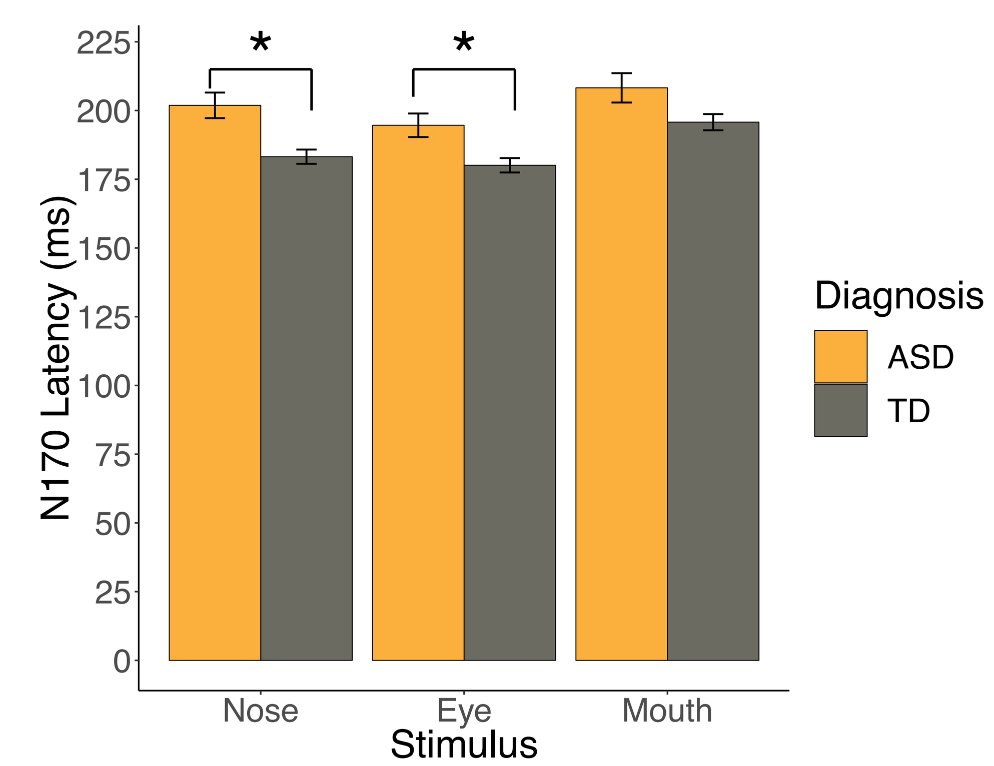
- Participants viewed black-and-white faces and houses preceded by a single crosshair in either the upper, middle, or lower portion of the screen.
- Gaze was thus directed to the eyes, nose, or mouth region of the face, and upper, middle, or lower region of the house.
- For analysis of the brain response to houses, all viewing positions were collapsed.



Results

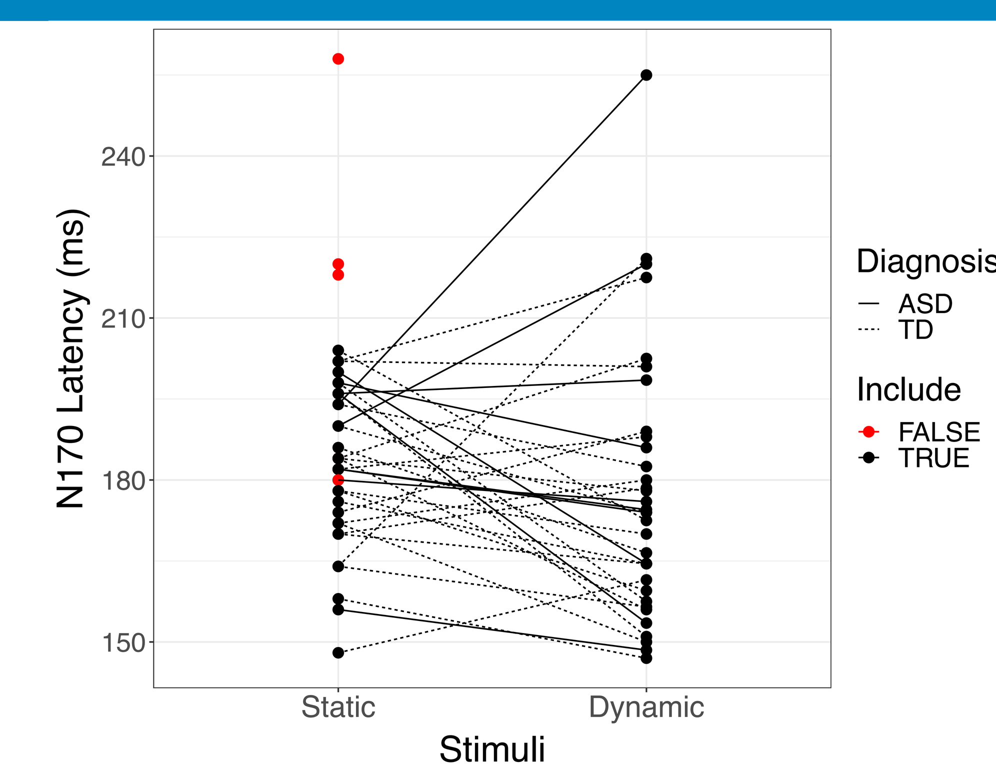


Grand Average Waveforms to Static Faces.
Right hemisphere N170 response when gaze was directed to the eyes or mouth of static faces.



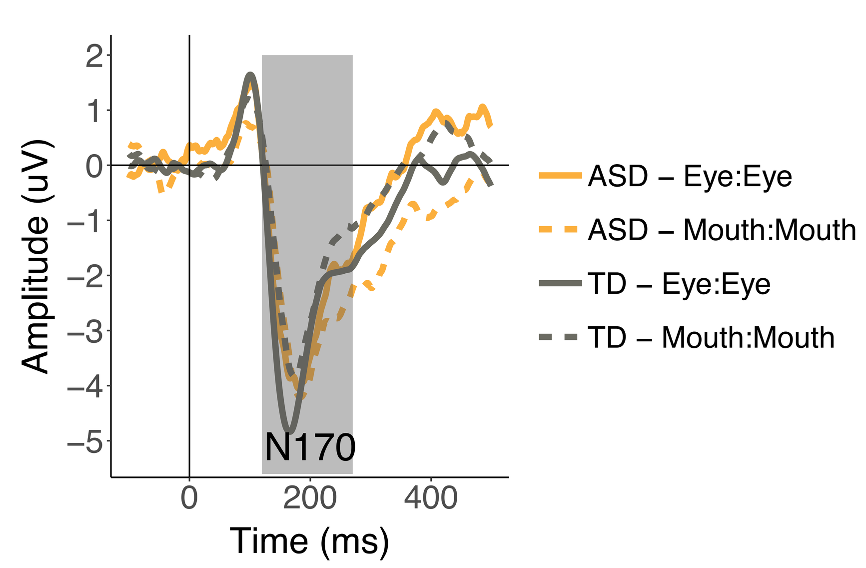
Neural Response to Static Faces.

- N170 latency differed significantly across stimuli ($F(3, 117)=7.21$, $p<0.01$) and diagnostic group ($F(1, 39)=6.04$, $p<0.05$).
- Individuals with TD had significantly faster N170s to eyes and nose of static faces than individuals with ASD (*, p<0.05), with no differences to houses and mouths between groups.

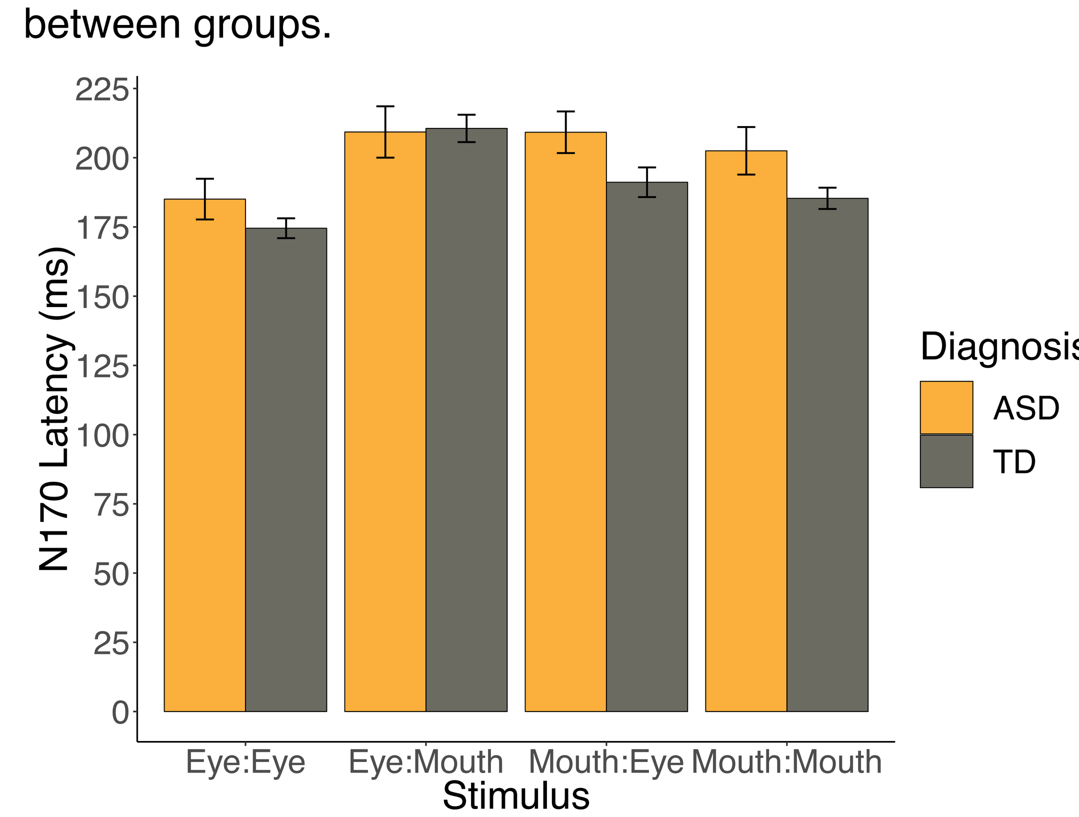


Data Loss to Dynamic Faces.

- Seven individuals who contributed useable data to static faces did not contribute useable data (fewer than 10 artifact-free trials per condition) to dynamic faces (indicated in red).
- Three of these individuals had the three longest N170 latencies to static faces.

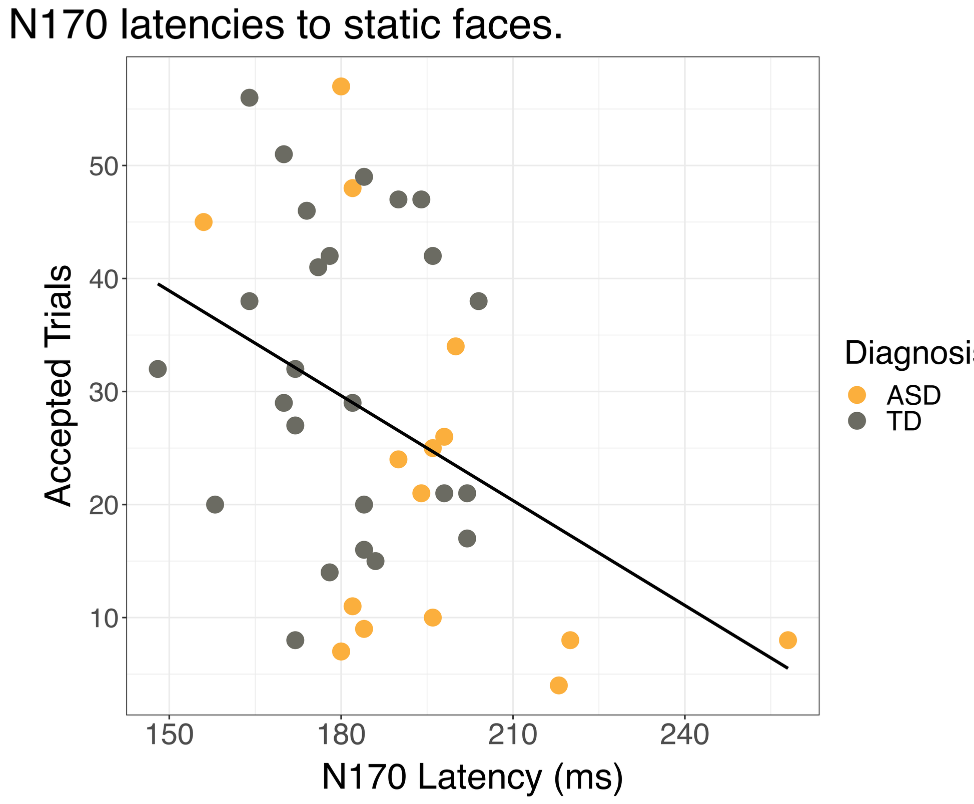


Grand Average Waveforms to Dynamic Faces.
Right hemisphere N170 response to gaze-contingent eye and mouth movement.



Neural Response to Dynamic Faces.

- N170 latency differed significantly across stimuli ($F(3, 96)=9.09$, $p<0.01$), but not between diagnostic groups.



Increased data loss to dynamic faces associated with slower N170 to static faces.

- There was a significant negative correlation between number of artifact-free trials in the dynamic face paradigm and N170 latency to static faces ($r(39)=-0.38$, $p<0.05$).

Conclusions

- This work replicates previous findings of delayed N170 latencies to static faces but not houses in individuals with ASD.
- Interestingly, similar N170 latency delays were not seen in response to gaze-contingent dynamic faces.
- These differences in brain responses between dynamic and static stimuli could reflect differences in the nature of the task (passively watching a face appear vs. actively provoking a facial movement) or differences in brain response to photograph stimuli compared to computer-generated stimuli.
- These discrepant findings could also be a relic of data loss in the dynamic faces paradigm, as individuals who had a longer N170 latency to static faces contributed fewer artifact-free trials to data analysis of dynamic stimuli, and were therefore more likely to be excluded.
- This work highlights the importance of considering data loss in dynamic paradigms. Missing data can provide meaningful information but can also limit the generalizability of findings.
- Ongoing work will make gaze-contingent paradigms more accessible to all participants by incorporating motion-responsive technology to paradigm administration to maximize data collection during moments of attention and stillness.

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