Transdiagnostic Relationships Among Social Communication and Neural Reponses to Dynamic Stimuli

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Background

- Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by social impairment, restricted and repetitive behaviors, and atypical response to sensory information.
- Schizophrenia (SCZ) is a thought disorder marked by delusions, hallucinations, speech, disorganized motor skills and negative symptoms (APA, 2013).
- Individuals with SCZ also experience deficits in social communication and social interactions similar to those with ASD (Abdi, Sharma, 2004).
- In order to examine social communication impairments across disorders, self-report and clinician-report assessments can be utilized.
- The electroencephalogram (EEG) can be used to explore possible neural similarities between these disorders.
- Previous research has revealed that the latency of the N170 in response to facial stimuli is longer in adults with ASD than typically developing (TD) adults (McPartland et al., 2004).
- The purpose of this study was to explore self- and clinician-report measures of social functioning in relation to brain response to social stimuli across diagnoses.

Current Study:

- This study investigated the relationships among self-report and clinician-rated measures of social communication and the N170 across adults with ASD, SCZ, and typically developing (TD) controls.

Methods

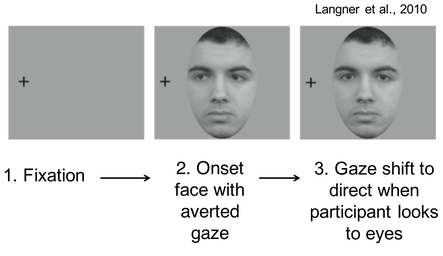
Participant Demographics:

	N	Sex	Age (SD)	FSIQ (SD)
ASD	16	11M	24.07 (4.89)	104.75 (14.46)
SZ	16	14M	25.03 (3.13)	100.19 (11.44)
TD	11	7M	25.38 (4.39)	118.00 (14.20)

Experimental Paradigm:

- Eye-tracking (ET) and EEG were co-recorded while the participant underwent a gaze-contingent viewing paradigm. Participants viewed 112 faces that were matched on low-level visual features. The faces responded to the participant's gaze by looking at (direct gaze) or away from (averted gaze) the participant.

Figure 1. Trial Structure. Participants first fixated on a crosshair for ~300ms (Panel 1). Then a face displaying either direct or averted gaze was presented (Panel 2). After the participant looked to the eyes of the face for ≥500 ms, the gaze shifted and remained onscreen for 600 ms (3). (Naples et al., 2017).



Clinical Measures:

- IQ was assessed using the *Wechsler Abbreviated Scale of Intelligence (WASI-II).*
- The *Autism Diagnostic Observation Schedule, Second Edition (ADOS-2),* Module 4 was utilized as a clinician-rated measure to capture symptoms related to autism. It is scored based on two domains: Communication and Social Interaction and Restricted and Repetitive Behaviors (RRBs)
- The *Social Responsiveness Scale, Second Edition (SRS-2)* was used as a self-report measure of social communication impairments. This measure includes the following subscales: Social Awareness, Social Cognition, Social Communication, Social Motivation and Restricted Interests and Repetitive Behavior
  - Participants self-reported behavior on a scale of 1 (not true) to 4 (almost always true)

Methods

EEG and ET Data Acquisition and Collection:

- EEG was recorded at 1000 Hz with a 128-channel Hydrocel Geodesic Sensor net.
- ET data was collected using an Eyelink-1000 remote camera system.

Event-related Potential (ERP) Analysis

- N170 (150-300ms) was extracted from electrodes over left and right occipitotemporal regions (see Figure 2).
- Data were filtered at 0.1 to 30Hz and segmented from 100 to 500ms relative to shift in stimulus gaze. Trials with eye movements greater than 1.5 degrees of visual angle were excluded.

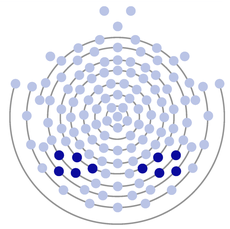


Figure 2. Selection of electrodes for analysis.

- A series of correlations were run between *ADOS-2 Mod 4* Algorithm Total, *SRS-2* T-scores and N170 for participants across the three diagnostic categories.

Results

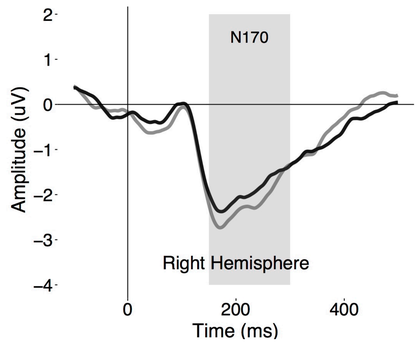


Figure 3: Grand averaged waveforms to direct and averted gaze
Grand average waveform for 43 participants diagnosed with ASD, SCZ and TD in response to direct and averted gaze contingent tasks

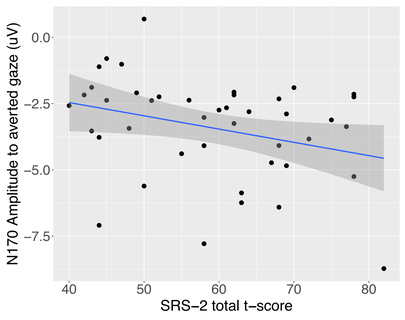


Figure 4: N170 amplitude to averted gaze and SRS-2 T-score

A significant negative correlation was found between the N170 amplitude to averted gaze and *SRS-2* total T-score, r = -0.31, p = 0.04, such that stronger response to averted gaze was associated with increased autistic traits

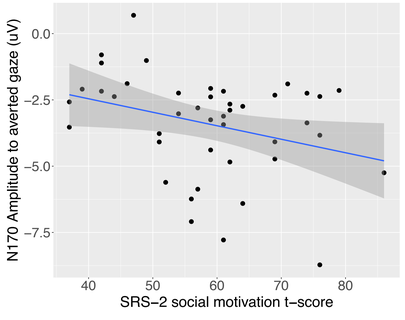


Figure 5: N170 amplitude to averted gaze and SRS-2 social motivation T-score

A significant negative correlation was found between the N170 amplitude to averted gaze and *SRS-2* social motivation T-score, r = -0.32, p = 0.04, such that stronger response to averted gazed was associated with greater social motivation impairment

There were no significant correlations between the N170 latency to direct and averted gaze contingent tasks, the *SRS-2* T-scores, and the *ADOS-2*. There was a marginally significant negative correlation between the *ADOS-2* algorithm total and the N170 amplitude to direct gaze, r = -0.29, p = 0.06, suggesting that stronger response to direct gaze was associated with more social communication impairments.

Results

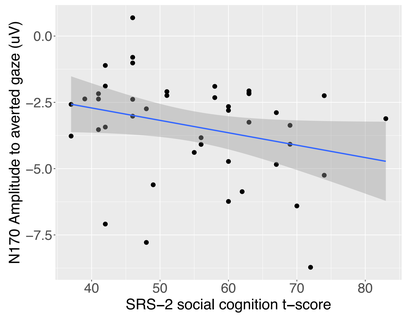


Figure 6: N170 amplitude to averted gaze and SRS-2 social cognition T-score

A marginally significant negative correlation was found between the N170 amplitude to averted gaze and *SRS-2* social cognition T-score, r = -0.29, p = 0.06, such that stronger response to averted gaze was associated with greater social cognition impairment

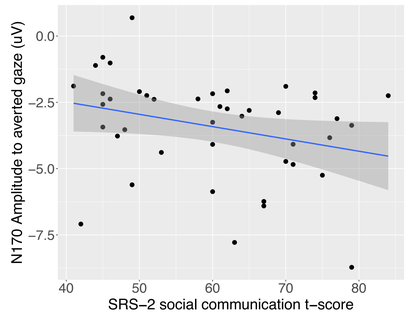


Figure 7: N170 amplitude to averted gaze and SRS-2 social communication T-score

A marginally significant negative correlation was found between the N170 amplitude to averted gaze and *SRS-2* social communication T-score, r = -0.29, p = 0.06, such that stronger response to averted gaze was associated with greater social communication impairment

Discussion

- We explored the association between social functioning and brain responses to dynamic social stimuli in individuals with ASD, SCZ, and TD controls.
- Results suggest that the *ADOS-2* and *SRS-2* measure distinct aspects of social communication associated with differential patterns of brain response to gaze-related stimuli, the former being associated with direct gaze and the latter being associated with averted gaze.
- We found that increased scores of social impairment correlated with a larger N170 amplitude (stronger response) when looking at eyes that shifted to averted gaze.
- Response to averted gaze may reflect interpretation of the stimulus (e.g. as a sign of rejection or disinterest) and is thus more influenced by factors captured by the *SRS-2*, such as social motivation and cognition.
- In contrast, neural response to direct gaze may be more associated with observable gaze-related behaviors as measured by the *ADOS-2*.
- This suggests the importance of measuring social communication in a comprehensive fashion, utilizing multi-informant ratings across multiple measures.

Limitations:

- The sample size utilized in this study was small
- The three diagnostic groups were not matched on IQ; future research must address the potential influence of cognitive ability on the processes under study.

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