Early visual processing indicates excitatory/inhibitory imbalance in adults with autism and schizophrenia

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Background

- Visual Evoked Potentials (VEP) are robust EEG responses that index the integrity of the visual system with amplitudes that reflect the ratio of excitation and inhibition (E/I) in the brain
- Past literature has shown a neural phenotype of **attenuated VEP P1-N75 amplitudes** in disorders with sensory features, including autism spectrum disorder (ASD) and schizophrenia (SZ), though the two groups have not been compared in the same study
- ASD and SZ share overlapping behavioral phenotypes of social and communicative difficulties, termed *negative symptoms* in schizophrenia
- E/I imbalance has been implicated as a common physiological cause of these symptoms in both conditions

Specific Aims

1. Compare the neural phenotype of low level visual processing in adults with ASD and SZ to adults with typical development (TD), as measured by VEPs
2. Assess the relationship of the VEP components to social symptomology

Method

	N (*n* male)	Mean (SD) Age	IQ *	ADOS CSS *
ASD	27 (22)	25.8 (5.6)	106 (17)	7.3 (2.3)
SZ	19 (16)	23.4 (3.4)	97 (12)	4.9 (3.1)
TD	29 (13)	26.2 (5.8)	114 (15)	1.4 (0.7)

Participants

- Diagnostic groups significantly differed in IQ (ASD=TD>SZ) and ADOS Calibrated Severity Score (CSS) (ASD=SZ>TD) (* p<.05)

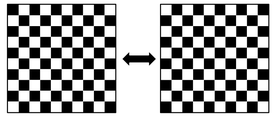


Figure 1. Experimental stimuli reverse at a rate of 1 Hz

EEG acquisition and processing

- EEG was recorded at 500 Hz with a 128 HydroCel Geodesic Sensor Net while participants viewed a 22x22 black and white checkerboard (100% contrast) reversing at a rate of 1 Hz (Figure 1)
- EEG was processed in EEGLAB:
  - Filtered from 0.1-30 Hz
  - Re-referenced
  - Segmented from -150 to 300 ms
  - Artifact detected
- Peak amplitudes and latencies were extracted for the N75 (60-100 ms) and P1 (80-180 ms) components at Oz (Figure 2)

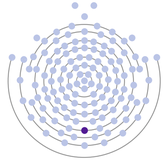
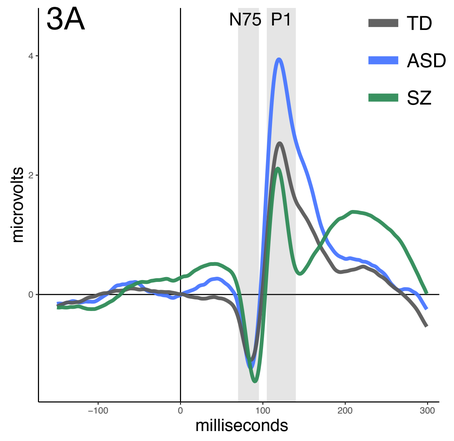


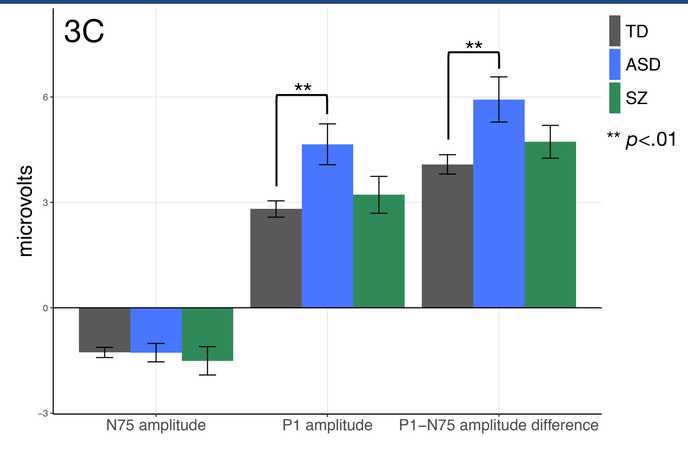
Figure 2. Electrode selected for analysis: 75 (Oz)

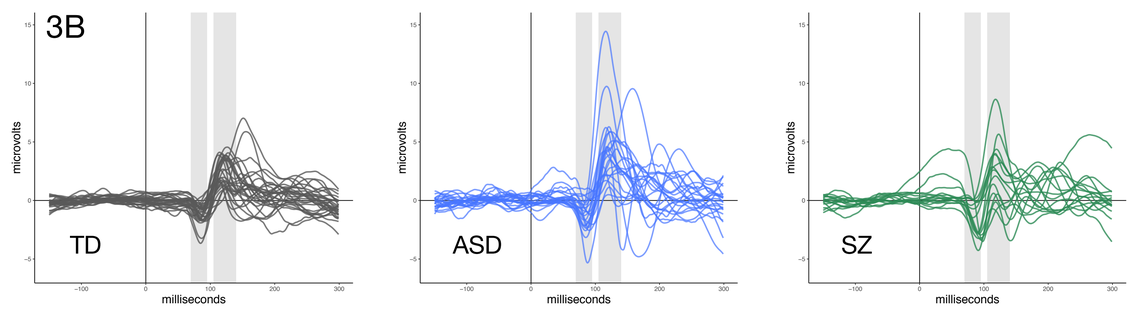
Statistical Analyses

- The difference in N75 and P1 amplitudes was calculated for all participants
- One-way ANOVAs tested for group differences in latency and amplitude for N75 and P100, and P1-N75 amplitude
- Pearson correlations were used to assess relationships of ERP components with autism severity (ADOS) and negative symptom severity (PANSS)

Results





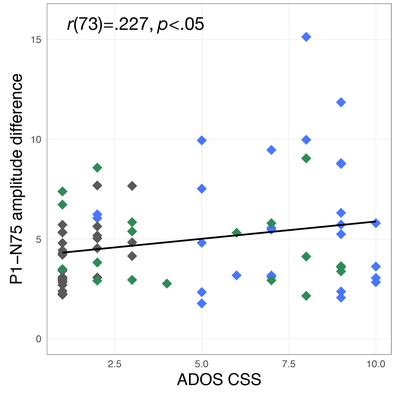


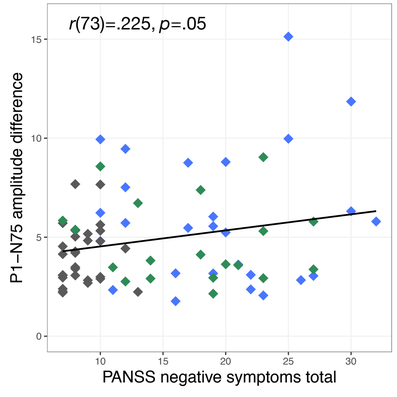
Individuals with autism show greater average VEP amplitude

Figures 3A, 3B. VEP grand average (3A) and individual averages (3B) with the N75 and P1 components highlighted

Figure 3C. There was a significant main effect of diagnostic group on P1 amplitude [F(2, 72)=4.88, p=.01] and P1-N75 amplitude [F(2, 72)=4.10, p=.02] such that the ASD group had a greater P1 amplitude and a greater P1-N75 amplitude difference than the TD group. There were no group differences in P1 or N75 latency (p's>.05).

Individual differences in VEP components correlate with social-communication impairments





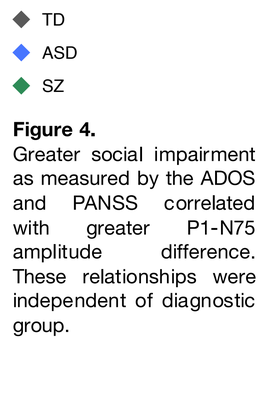


Figure 4. Greater social impairment as measured by the ADOS and PANSS correlated with greater P1-N75 amplitude difference. These relationships were independent of diagnostic group.

Conclusions

- Differences in the P1-N75 amplitudes of the VEP in adults with ASD are consistent with **intact visual processing** circuitry but **atypical E/I balance,** aligning with prior research
- P1-N75 amplitude is associated with clinician-reported social symptomatology across diagnostic groups, demonstrating a **link between objective neural responses and social function in a transdiagnostic fashion**
- These findings suggest **shared pathophysiology between SZ and ASD** and demonstrate the promise of transdiagnostic research for informing social-communicative biomarker development in neurodevelopmental disorders
- Future studies will look at the link between basic visual processing and higher order social information processing

References

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