Abnormal N1/P1 responses in children with ASD elicited by both low and high spatial frequency gratings.

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Background

There is increasing evidence of atypical visual perception in individuals diagnosed with autistic spectrum disorders (ASD) (see Milne et al. 2005 and Dakin & Frith, 2005). The level at which these atypicalities occur is unclear. We tested the integrity of low level visual perception in individuals with autism by measuring the amplitude and latency of the visual evoked potential (VEP) elicited by simple sine wave gratings across a range of spatial frequencies (0.5, 1, 4 & 8 cpd). The VEP occurs at around 100 ms and is the first identifiable response to visual stimulation, therefore if children with ASD show VEP differences compared to controls, this will suggest that the very early stages of visual perception are atypical in these children.

Participants

Data is reported from 35 participants (31 male), 18 of whom were diagnosed with ASD, and 17 typically developing controls. There were no significant age or performance IQ differences between the groups.

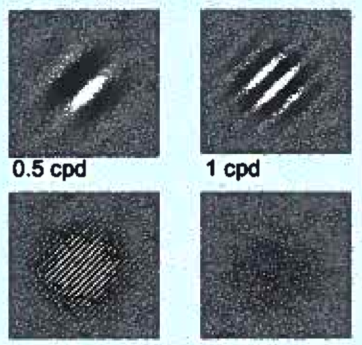
	Age	FSIQ	PIQ	SCQ score*	CARS Score**
ASD Mean *(S.D.)*	12 years 2.5 months *(2 years 7 months)*	103.88 *(18.28)*	103.63 *(17.38)*	24.12 *(6.53)*	29.00 *(4.99)*
Control Mean *(S.D.)*	13 years 5 months (2 years 7 months)	117.00 *(12.67)*	111.88 *(8.82)*	0.90 *(0.88)*	15.00 *(0.00)*

*Social Communication Questionnaire (Rutter et al. 2003). A score of 22 is the cut-off for autism

**The Childhood Autism Rating Scale (Schopler et al., 1980). A score of 30 is the cut off for autism

Experimental Design

Stimuli were 4 sinusoidal gratings at either 0.5 cpd, 1 cpd, 4 cpd or 8 cpd. Each stimulus was presented 72 times in random order. Participants were instructed to watch the screen and press a response key after seeing a picture of a zebra (which was randomly interspersed between the experimental stimuli). The zebra served as an attentional cue and VEPs elicited by the zebra stimulus were not analysed.



0.5 cpd | 1 cpd | 4 cpd | 8 cpd

EEG Acquisition

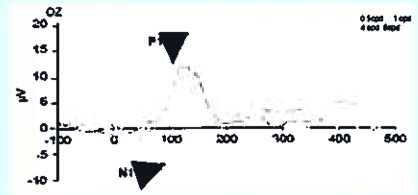
- 128 Ag/AgCl electrodes (Electrical Geodesics.com).
- On-line filtering 0.1 – 80Hz sampled at a rate of 1000Hz.
- Off-line filtering 40Hz low pass.
- Epochs segmented around stimulus duration (-107 msec – 507 msec).
- Occipital sites corresponding to the 10/20 system were analysed by averaging the signals from electrodes 76 and 82 (Oz).
- After artefact detection, the mean number (S.D.) of trials used in the analyses were 69.39 (2.25) for the ASD group and 70.28 (1.39) for the control group.

Behavioural Results

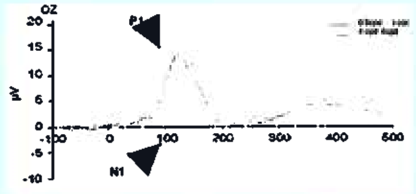
	Number of Zebras (Max. = 36)	Mean RT	Commission Errors
ASD *(S.D.)*	33.6 *(3.07)*	403.77 *(41.49)*	1.81 *(2.04)*
Control *(S.D.)*	33.5 *(3.03)*	397.3 *(42.16)*	1.00 *(1.11)*

There were no significant differences between the ASD and control group in the number or speed of zebra responses.

Electrophysiological Results: Group Differences



Average waveforms of control group

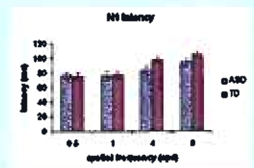


Average waveforms of ASD group

Topo plot of whole head at 100 ms, showing increased negativity in the TD group.

TD group (105ms) ASD group (105ms)

Latency N1

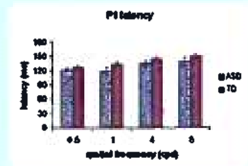


The N1 evoked by the higher spatial frequencies peaks significantly sooner in the children with ASD:

4cpd $F(1,33) = 19.4$, $p < .001$

8cpd $F(1,33) = 10.7$, $p < .005$

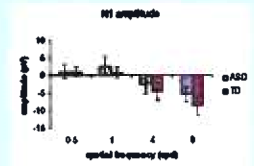
Latency P1



The P1 evoked by all spatial frequencies peaks significantly sooner in the children with ASD:

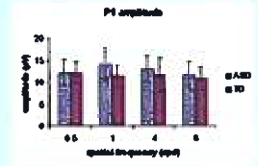
Main effect of group $F(1,33) = 16.1$, $p < .001$

Amplitude N1



The N1 is reduced in some* of the children with ASD leading to a marginally significant group difference between the amplitude at 8 cpd $F(1,33) = 3.83$, $p = .059$

Amplitude P1

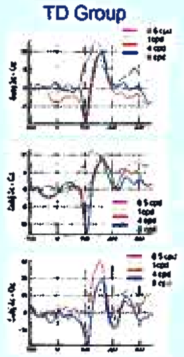


No significant group differences of P1 amplitude.

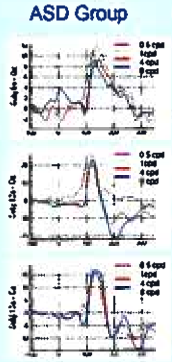
Electrophysiological Results: Individual Data

The N1 / P1 complex evoked by each spatial frequency was plotted for each participant. *61.2% of the participants with autism did not show a typical N1 at the higher spatial frequencies. Examples of normal and atypical waveforms are presented below:

TD Group

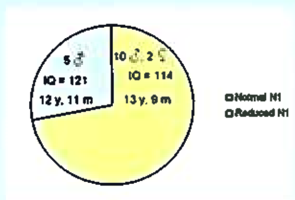


ASD Group

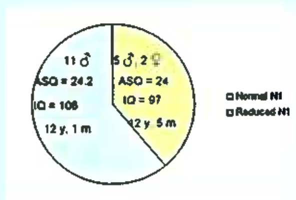


Proportion of children in each group showing normal N1 or reduced N1.

TD Group



ASD Group



Summary

The latency of both the N1 and the P1 evoked by a range of spatial frequencies is reduced in children with ASD. The magnitude of the N1 evoked by high spatial frequency is reduced in ASD. The finding reported here reflects the fact that 61.2% of the participants with autism did not have a negative component in their waveforms. This lack of N1 in some participants does not appear to correlate with age, IQ, severity of symptoms (as measured by the ASQ & CARS) or behavioural performance.

References

Dakin, S. & Frith, U. (2005). Vagaries of Visual Perception in Autism, *Neuron*, 48, 497 – 507. Milne, E., Swettenham, J. & Campbell, R. (2005). Motion perception in autistic spectrum disorder: A review. *Current Psychology of Cognition*, 23, 3 – 33. This work is supported by The Bial Foundation and the Economic and Social Research Council.