BRAIN OSCILLATIONS OF FACE AND GAZE PROCESSING IN CHILDREN WITH AUTISM SPECTRUM

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Background

In autism spectrum disorder (ASD), processing of human faces and eye gaze differ from that of typically developing (TD) individuals. The emergence of these differences appears to consist of trajectories that are affected by brain development and may interact with cognitive developmental delays (DD).

Aims

- To study cortical activity in 5- to 8-year-old children with ASD, in response to socially meaningful stimuli
- Explore different frequencies of brain oscillations in response to faces and direct eye gaze
- Compare the results to TD and DD control participants

Methods

We investigated brain activity during the processing of faces vs. cars and direct vs. downcast gaze [Fig 1] in children with ASD using electroencephalography (EEG). Theta-, alpha-, beta- and gamma-frequency oscillations were analyzed following stimulus onset. Control participant groups [Table I] included typically developed (TD) and developmentally delayed (DD) children.

Table I. Participant characteristics.

	ASD	TD	DD
Gender (boys/girls)	16/1	14/3	9/3
Chronological age	6.3 (4.7–8.3)	6.3 (4.5–8.4)	6.8 (5.7–8.1)
IQ	61 (42–89)		59 (52–68)

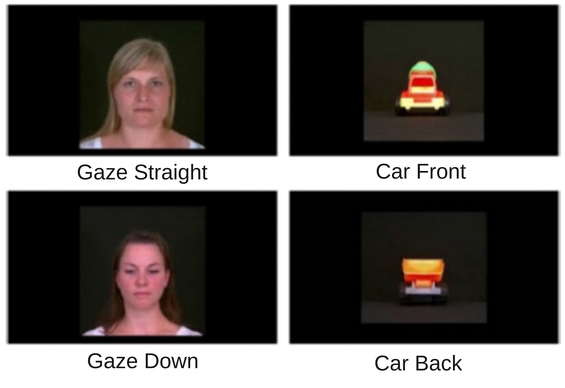

Figure 1. Face and toy car stimuli.

Results

For the ASD group, maximum difference in EEG power was found between conditions with 1) faces vs. cars at parieto-occipital [Fig 2], and 2) straight vs. downcast gaze at central electrodes in the theta frequency band. This response differed from that induced by these stimuli in TD and DD participants [Table II].

Table II. EEG power (μV ^{2}/cm) in those groups and frequency bands where statistically significant differences between stimulus conditions were observed (C=central, F=frontal, O=occipital , P=parietal).

Group	Band	Frq (Hz)	Site	Face	Car	*t*	*p*
ASD	theta	5-7	PO	6.98	5.83	2.66	0.017
DD	alpha	11-12	F	1.22	1.06	2.44	0.039
TD	beta	14-16	F	0.66	0.61	3.63	0.002
				Gaze Straight	Gaze Down		
ASD	theta	6-7	C	5.62	4.48	3.01	0.008
DD	alpha	12-13	F	0.9	1.12	-3.21	0.009

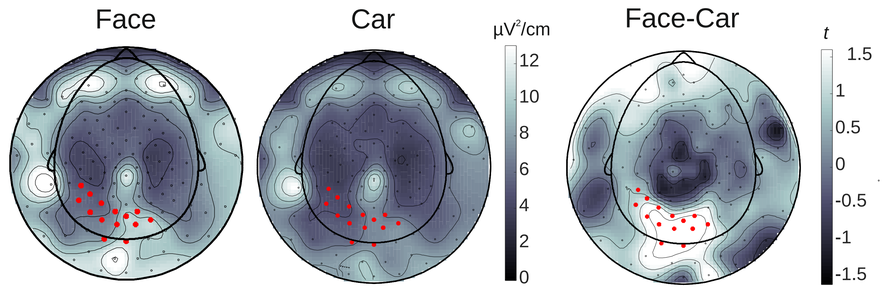

Figure 2. Theta-band (5–7 Hz) EEG power in participants with ASD following presentation of face and car stimuli. The comparison between the conditions in *t*-values is indicated in the right panel (Face-Car). Increased power for faces vs. cars was found in a parieto-occipital cluster of electrodes (red markers).

Conclusions

- Theta-band oscillations have been previously associated with attention allocation
- Increased theta-power in ASD may reflect increased processing demands related to:
  1) intrinsic deficits in face processing , or
  2) limited expertise with faces
- Alternatively, theta -band oscillations in children with ASD may index functionally different processes (e.g., down-tuned alpha) rather than attentional allocation to faces as in TD children

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