Atypical pattern of frontal EEG asymmetry to direct gaze in young children with autism spectrum disorder

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Background

- It has been suggested that another person's direct gaze is not socially motivating for individuals with autism spectrum disorder (ASD) and therefore they ignore it.
- The assumption has gained psychophysiological support from our previous findings indicating that school-aged children, high-functioning children with ASD did not show normative left-sided, approach-related frontal EEG activity to direct gaze (Kylliäinen et al., 2012).
- Relative right- and left-sided asymmetries in the frontal alpha-band EEG activity have been associated with activation of the avoidance- and approach-related motivational brain systems, respectively.
- **The aim of the study** was to find out whether abnormal motivation-related brain responses to direct gaze would be observed also in **young, low-functioning children with ASD**.

Methods

Participants.

- Twenty children with autism (ASD), 19 typically developing children (TD) and 17 with developmental delay (DD) participated in the study. After the artefact rejection 7 children of each group did not have ≥ 2 trials/condition and had to be left out of the further analysis.
- The chronological age matched TD children and the IQ matched DD children did not show strong ASD symptoms according to the SCQ. The ASD children, instead, had robust autistic behaviour (Table1).

Group	N (girls)	Age, years	IQ	ADOS-2, Comparison score	SCQ
ASD	12 (1)	4.3 (2.8-5.8)	65 (47-88)	8 (5-10)	
TD	12 (3)	4.6 (2.8-5.8)			3 (0-7)
DD	10 (1)	5.1 (3.9-7.2)	57 (42-79)		9 (4-18)

Table 1. Participant info

Design.

- Continuous EEG (EGI Geodesic 128 channel system) activity was measured whilst the children viewed photos of faces with direct or downcast gaze and cars pictured from front or back view (Figure 1).
- On each trial, the stimulus was static for the first 2 seconds and then loomed towards the child for 3 seconds, creating an impression of an approaching person (or a car).
- At the end of each trial there was a task for the child to press either red or green button in order to launch a short reward animation.

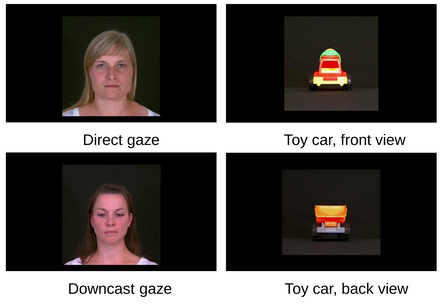

Figure 1. Stimuli in different conditions

Analyses.

- The data was carefully video analysed second by second. The most of the quality data was able to obtain during the first second of the trial and during the third second of trial when the image started to move.
- Frontal EEG asymmetry was analysed separately to the static (-100-1000ms) and moving phases of the stimuli (1900-3000ms).
- The fast Fourier transformation was done for the artefact and ICA corrected epochs. The power density values ($\mu V^2/Hz$) of each condition within the alpha band (6–10 Hz) were calculated, To generate a measure of frontal asymmetry, ln-transformed power density values from individually selected three left channels were subtracted from values for the equivalent right channels.

Results

- The results showed that the typically developing children showed greater approach-related frontal EEG activity to direct gaze compared to downcast gaze. In children with ASD, the downcast gaze elicited greater approach-related frontal EEG activity compared to the direct gaze. In the children with developmental delay without ASD, there was no significant difference between the gaze conditions in the frontal EEG activity. These patterns of activity were obtained for the moving but not static phases of the stimuli.

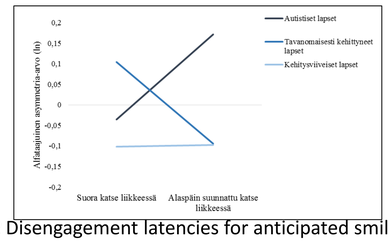

Figure 2 Disengagement latencies for anticipated smiling and non-smiling faces in all groups of children

- **The gaze condition** did not to affect the disengagement latencies.
- **The re-engagement latencies** in all groups tended to be shorter (p = .075) for smiling than non-smiling faces.
- There were no significant differences in the disengagement and re-engagement latencies between **the anticipated moving and non-moving toys**. There were also no differences between the three groups in the toy conditions.

Discussion

- The pattern of frontal EEG activity to direct gaze was different in children with ASD compared to the other groups. The findings suggest that the lack of normative approach-related motivation towards another person´s direct gaze is evident early in the autistic development. It also strengthens the role of eye contact in abnormal social development of children with ASD. Interestingly, the dynamic stimuli seemed to be more sensitive than static stimuli to reveal differences in the motivation-related brain responses.

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