Effect of familiarity on reward anticipation in children with and without autism spectrum disorders

Katherine K.M. Stavropoulos1,2 & Leslie J. Carver1
1. Developmental Neurosciences Lab, University of California, San Diego
2. McPartland Lab
Yale Child Study Center, New Haven, CT

BACKGROUND

• Autism spectrum disorder (ASD) is estimated to affect up to 1 in 68 children in the US (Centers for Disease Control and Prevention [CDC], 2014).
• Documented difficulties in social communication, and presence of repetitive and restricted behavior and interests.
• Social motivation hypothesis states that individuals with ASD are less able to socially communicate independently due to lack of motivation to respond in social interactions (Volkmar et al., 2003).
• Previous work provides support for the social motivation hypothesis (Stavropoulos & Carver, 2014) using electrophysiological measures.
• However, it is unclear if social reward is mediated by familiarity in ASD.
• Do children with ASD have increased reward activity when viewing a familiar face?
• Mixed results in previous literature (Pierce & Rast, 2008; Weiste et al., 2010).
• Current study designed to investigate whether familiar faces increase reward anticipation in children with ASD vs. their TD peers.

METHODS & PARTICIPANTS

SPN

• The stimulus preceding negativity (SPN) is a slow negative waveform occurring before participants receive feedback about their performance.
• The SPN is larger when feedback is informative (Chawla & Buxton, 1991), and when participants feel control over the outcomes of a task (Maclaren, Yassman, & MacKay, 2010).
• The SPN reflects expectation of reward, and activates the dopaminergic reward system (Van Bokel & Boker, 2004).
• Individuals with damage to the dopaminergic system (e.g., Parkinson’s) show reduced SPN amplitudes (Stavropoulos et al., 2008).

Present Study

• The present study was designed to understand the neural response to feedback anticipation when feedback was accompanied by either a familiar face (or arrow) or an arrow picture.
• We controlled for rewards between face and non-face blocks.
• We made the face and arrow incidental to the task (as participants did not rely on the picture for feedback).
• We controlled for visual stimulus differences by using scrambled faces in the arrow condition.

Participants

• 28 children (14 ASD, 11 TD, 3M, 14 TD, 11F, 3M).
• ASD: mean age = 8.56 yrs, SE = .39
• TD: mean age = 7.94 yrs, SE = .39
• Participants were recruited through postings online and flyers.
• Exclusionary criteria for children in the ASD group included: Genetic causes of ASD (e.g., Fragile X), history of seizures, brain injury, neuropsychiatric disorders, or any concurrent psychotropic medication use (other than ASAB).
• Exclusionary criteria for TD participants included all of the above plus an immediate family history of ASD.

Recording

• EEG data were collected using a 32 channel electro cap (Electro-cap international), which was placed according to the international 10-20 system.
• Electrodes were referenced to and re-referenced to linked mastoids. Electrode were also placed above and below the left eye and at the outer canthus of each eye to record electro-oculoculor activity (EOG).
• Impedance was kept below 5 kΩ before testing began, and were verified after testing.
• The data were digitized at 250 Hz for 2500 ms, a 200 ms pre-response baseline was included, the 60 Hz notch filter engaged, and band-passed using a 4th order filter (0.16-δ0.30 Hz), and 10 Nc high pass filter.
• EEG data were divided into two groups with at least 10 artifact-free trials for each condition.

Stimuli and Procedure

• 240 trials were presented in five separate blocks (40 familiar face trials, 40 “familiar” scrambled arrow trials, 40 unfamiliar face trials, 40 “unfamiliar” scrambled arrow trials).
• Participants were instructed to guess whether the left or right side was “correct” with a button press.
• Participants chose left (or right) was indicated for 2000 ms before feedback was presented.
• Participants were told that they could earn a golden checker (i.e., correct answers) that could be exchanged for a goldfish cracker (i.e., all other trials did not give the goldfish).
• Importantly, trials were pseudo-randomly pre-programmed as correct or incorrect by the computer in a 50/50 distribution.

Figure 1. Schematic of the stimuli and task in the familiar face condition with a correct response (left), and familiar non-face (arrow) condition with a correct response (right). Incorrect responses were identical in structure, with the goldfish crossed out and a frowning face in the face condition, and the goldfish crossed out and a downturned face arrow in the non-face condition.

Figure 2. (Left) Grand averaged waveforms for TD children from the Stimulus Preceding Negativity (SPN) prior to familiar faces, unfamiliar faces, familiar arrows, and unfamiliar arrows. The area between 210 and 10 ms, used for statistical analysis, is highlighted with a grey box. (Right) Grand averaged waveforms for children with ASD from the Stimulus Preceding Negativity (SPN) in anticipation of familiar faces, unfamiliar faces, familiar arrows, and unfamiliar arrows. The area between 210 and 10 ms, used for statistical analysis, is highlighted with a grey box.

Brain-Behavior Correlations

• In children with ASD, a significant correlation was found between SRS-2 T-scores and SPN magnitude in the face condition, (r(12) = .95, p < .01). (Figure 4).

CONCLUSIONS

• Children with higher levels of social impairment (reflected by higher SRS-2 scores) evidenced a decreased SPN when anticipating faces compared to individuals with lower levels of social impairment (reflected by lower SRS-2 scores).

IMPLICATIONS

• The current study replicates our previous findings that TD children evidence a larger SPN component when anticipating familiar faces (Stavropoulos & Carver, 2013), but that children with ASD do not show this effect (Stavropoulos & Carver, 2014).
• The current study suggests that older children (both TD and ASD) do not anticipate upcoming familiar faces more than unfamiliar faces (although for TD children, faces elicit a larger SPN component versus arrows and suggests that TD children find familiar faces especially rewarding).
• Children with ASD, on the other hand, do not have differences between conditions.
• Our findings differ from some previous investigations of familiar versus unfamiliar faces in ASD (Pierce & Rast, 2008), but are in accordance with others (Maclaren et al., 2010).
• Differences in methods may explain these discrepancies (e.g. Pierce & Rast, 2008) utilized multiple exemplars of familiar and unfamiliar faces in order to maximize FA activity.

REFERENCES


Funding Sources

Autism Speaks Weatherstone Predoctoral Fellowship (KKMS)
Autor Science Foundation Predoctoral Fellowship (KKMS)
RO1-MH096173-01A1 (McPartland)
Autism Speaks Weatherstone Predoctoral Fellowship (KKMS)