Pupillary Responses to Manipulations of Stimuli Type and Synchrony in Children with Autism Spectrum Disorder

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INTRODUCTION

- Pupil dilation is a physiological response that refers to the automatic expansion of the pupil (i.e., dilation).
- Pupillary response to visual and auditory stimuli is a reliable indicator of cognitive operations including preference\textsuperscript{3}, mental load\textsuperscript{4}, and emotional arousal\textsuperscript{5}.
- Autism Spectrum Disorder (ASD) is a neurodevelopmental disorder characterized by impairments in social communication and peer interactions\textsuperscript{6}.
- The current study measured pupillary responses to social and non-social information to understand the underlying cognitive processes involved in social information processing in ASD and how these differ from typical development (TD).
- It has been hypothesized that individuals with ASD show cognitive differences that are specific to social communication.

RESEARCH OBJECTIVES

1) Determine if processing of asynchronous stimuli can be indexed through pupillary change, and if responses differ between TD and ASD.
2) Determine if differences between pupillary responses to non-social and social information are driven by the processing of social or linguistic information.
3) Determine if pupillary responses to stimuli relate to ASD symptomatology.

METHOD

- Pupillary responses were recorded at a rate of 60 Hz, using a Tobii X60 eye-tracker.
- All trials were standardized for peak and average auditory volume, and visual luminance.
- Pupillary data were inspected for artifacts (i.e., blinks, loss of tracking, head movements) and corrected using linear interpolation. Useable data consisted of pupil traces at least 500ms in length in which artifacts did not make up more than 20% of the pupil trace\textsuperscript{6}.
- Average pupil diameter (across left and right pupil) was calculated for instances in which pupil data was captured in the area of interest.
- Mean pupil size was calculated for each stimulus condition and subtracted from mean pupil size of the preceding 1s of the inter-stimulus interval, which served as a baseline for each trial.

RESULTS

- The current study was unique in demonstrating a lack of social engagement in ASD at an early, pre-conscious level of physiological processing and supports the findings of a host of perceptual and behavioural studies,\textsuperscript{7}

- Some degree of intact processing in ASD was observed in response to processing asynchronous information at the physiological level with ASD individuals showing similar patterns in pupillary response to changes in synchrony.

- The Social Motivation Theory\textsuperscript{8} suggests that humans are biased towards orient towards social stimuli, be rewarded by engagement in social interactions, and strive to maintain social bonds. A lack of engagement may result in decreased social skills and an increase in ASD symptoms. This hypothesis was supported by the negative associations between pupil size and ASD symptoms.

- Future research will determine whether pupillary responses can be used as a screening tool for diagnosis.
- Other clinical implications include using pupil responses as a pre/post intervention measurement, or as a possible biofeedback mechanism\textsuperscript{9}.

DISCUSSION

- The current study measured pupillary responses to manipulations of stimuli type and synchrony. This was done using a 500ms baseline, which served as a pre-stimulus interval. Four social stimuli were presented: a story with a social interaction, a story with a non-social interaction, a visual slide of a non-social interaction, and a visual slide of a social interaction. The pupil was recorded for each stimulus condition.

- The results showed that there were significant differences in pupil size between social and non-social stimuli. The pupil diameter was larger in response to social stimuli than to non-social stimuli. This suggests that the pupil is a reliable indicator of social processing in ASD.

- The study also found that there were no significant differences in pupil size between TD and ASD participants, indicating that the pupil response is not specific to ASD.

- Future research could explore the use of pupil responses as a screening tool for ASD, or as a possible biofeedback mechanism.