Preliminary Investigation of Eye Gaze on Visual Scene Displays with a Navigation Menu by Individuals with Typical Development and Autism Spectrum Disorders

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Introduction

- Augmentative and alternative communication (AAC) is a compilation of methods and technology designed to supplement spoken communication for people with limited speech or language skills, including children with intellectual and developmental disabilities and autism spectrum disorder (ASD; Wilkinson & Hennig, 2007).
- Visual scene displays (VSDs) are a form of an AAC display in which language concepts are embedded into an image of a naturalistic event. They provide a high level of context by portraying events, people, actions, and objects within the context that they occur or exist.
- Because VSDs are accessed via the visual modality, it is critical to consider how individuals that use AAC attend to, perceive, and make sense of the visual information of the display (Wilkinson, Light & Drager, 2012).
- Understanding visual-cognitive processing of VSDs should inform effective communication display design, resulting in more effective and efficient AAC interventions.
- Previous research has indicated that humans in photographs attract visual attention from individuals with typical development (TD) and ASD (Wilkinson & Light, 2011; Wilkinson & Light, 2014).

Current Investigation

- This investigation furthers previous research by examining eye gaze fixation patterns on stimuli that resemble actual communication displays, which contain a main VSD and a navigation menu bar containing 4 smaller photographs (shown below):

Presentation of stimuli: 16 distinct stimuli are presented during 2 viewing conditions:

- *Free viewing*: The participant is given no instruction.
- *Cued viewing*: The participant is instructed to look at a particular item within the menu bar (i.e., "Look at the kids with the dog") by a pre-programmed command.

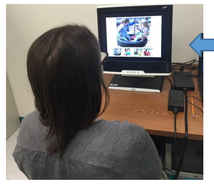
The stimuli include 4 bar locations: top (shown here), bottom, left, and right, as well as 4 language concepts: dog, swing, lunch, and book.

- The bar occurs in each location 4 times during the experiment.
- Each concept is depicted on the main VSD 4 times, with 4 distinct photographs for each concept.
- Each stimulus appears for 5 seconds in free viewing followed by 5 seconds in cued viewing.
- A white screen appears for 2 seconds before each stimulus.

Research Questions

- What elements attract attention within the main VSD during the free viewing condition (children, object, or background items)?
- How is visual attention divided between the main VSD and the navigation bar in free viewing versus cued viewing?
- What is the effect of the cue on the accuracy and efficiency of locating the target during the cued viewing condition?
- How, if at all, does the location of the navigation menu bar affect the accuracy and efficiency of locating the target during the cued viewing condition?

Procedures



TOBii T60 Eye Tracker

- The stimuli are presented to participant on 17 inch monitor.
- A Dell laptop connected to TOBii eye tracker controls stimulus presentation and data acquisition using TOBii Studio software.
- The TOBii eye tracker records point of eye gaze via a remote infrared camera that projects and detects light off of the participant's pupils and corneas.
- Calibration between the camera and the software is conducted at the beginning of each session.

Participants

Diagnostic category	Number (n)	Gender (% male)	Chronological age Range (mean)
TD	13	30%	13-33 (21)
ASD	5	100%	10-19 (15)

- This investigation will also extend to include additional participants with ASD as well as individuals with Down syndrome and Intellectual and Developmental Disabilities.

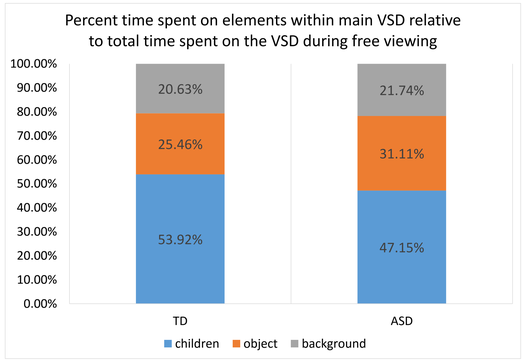
Results

- Heat maps (below) represent the intensity of fixations to the elements in the stimuli aggregated across the participants in each group.

Heat maps indicate that:

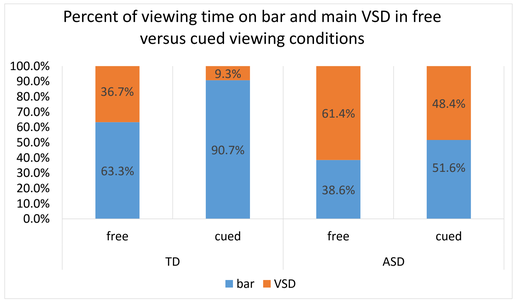
- TD participants spend more time examining the bar during free viewing.
- Both groups attend more to the target (indicated by red arrow) relative to the other items on the bar during cued viewing,
- Both groups attend more to children and "objects" within the VSD compared to the background.

Q1: What elements attract attention in the main VSD during free viewing?



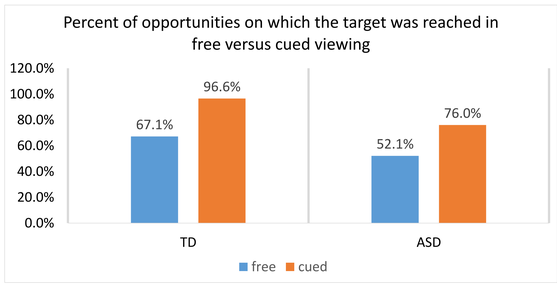
- Participants across both groups spend the greatest proportion of their viewing time fixating on the children within the VSD (~50%).
- Participants with ASD spend slightly less time fixating on the children and slightly more time fixating on the object.
- Participants across both groups spend the majority (~80%) of their time fixating on the children or the object of interest.

Q2: How is visual attention divided between the main VSD and the navigation bar in free viewing versus cued viewing?



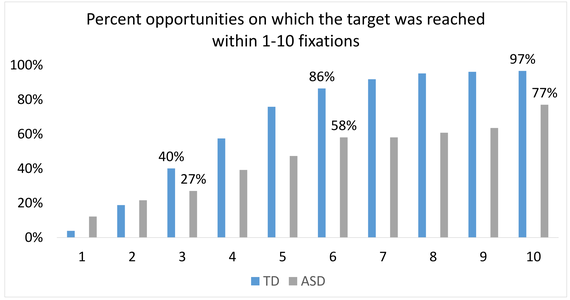
- Participants across groups spend more time fixating on the menu bar in cued viewing compared to free viewing.
- Compared to TD participants, participants with ASD spend more time fixating on the main VSD and less time fixating on the menu bar in both viewing conditions.

Q3: What is the effect of the cue on the *accuracy* of locating the target during cued viewing?



- Participants across groups are more likely to fixate on the target item in cued viewing compared to free viewing.
- Compared to participants with ASD, a greater proportion of TD participants arrive at the target during cued viewing.

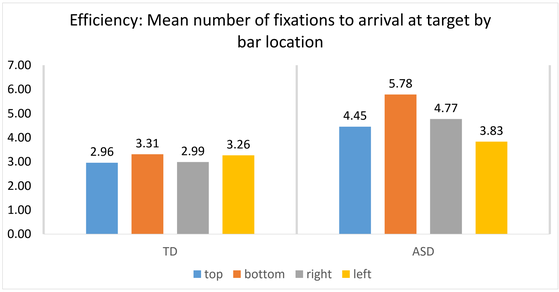
Q3: What is the effect of the cue on the *efficiency* of locating the target during cued viewing?



- The steep slope from 1-6 fixations for TD participants indicates that their search for the target is more efficient. In other words, they make less fixations before arriving at the target.
- The more gradual slope for participants with ASD indicates a less efficient search to arrive at the target.

Q4: How, if at all, does the location of the navigation menu bar affect the *accuracy* and *efficiency* of locating the target during the cued viewing condition?

- **Accuracy** (percent of opportunities on which the target is reached) does not vary notably by bar location.



- TD participants are arriving at the target after the cue with about the same level of efficiency across bar locations.
- Participants with ASD are most efficient at arriving at the target when the bar is on the left and least efficient when the bar is on the bottom.

Discussion

- Preliminary analyses of eye-tracking data among individuals with typical development and ASD indicate that individuals across groups are attending to both the main VSD and the menu bar.
- Across groups, less time is spent on the VSD and more time is spent on the bar during cued viewing.
- Individuals with typical development demonstrate a more accurate and efficient search to arrive at the target during cued viewing compared to individuals with ASD.
- The location of the menu bar may not affect the accuracy of locating the target, but it may impact the efficiency of arriving at the target, particularly for individuals with ASD.
- Additional participants with ASD and other intellectual and developmental disabilities are needed to increase understanding of how individuals with complex communication needs attend to, perceive, and process information on VSDs.
- This will provide guidance in order to create communicative displays that minimize visual processing demands and increase efficiency for individuals who use AAC.

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