# Attention Allocation during Static Social Scenes in ASD: Results from the ABC-CT Feasibility Study

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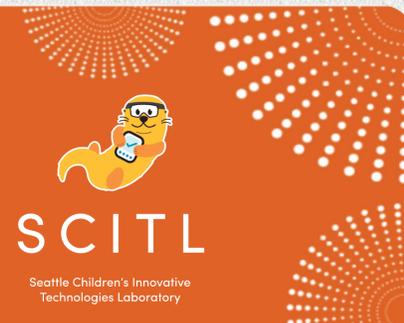
## Background

- Children with ASD spend less time looking at faces and eyes than their typically developing (TD) peers (Hanley et al., 2013; Riby & Hancock, 2008, 2009; Sasson et al., 2007).
- When faces are shown in the context of complex social situations, these diagnosis group differences may be larger (Hanley et al., 2013; Speer et al., 2007).
- Autism Biomarkers Consortium for Clinical Trials (ABC-CT) exists to validate well-known biomarkers in a large cohort, with the goal of identifying powerful biomarkers.
- We wanted to assess how to optimize the Static Social Scenes face preference variable as a potential biomarker.

## Objectives

1) To examine on-screen looking (%Valid) and face preference (%Face) of children with and without ASD when viewing static social photographs presented during eye tracking.
2) To assess face preference differences both:
   a) Across trials (to examine scene qualities that amplify group differences), and
   b) Over time within trials (to investigate how long stimuli need to be shown for differences to be detected).

## Participants

- Participants seen through the ABC-CT Feasibility study.
- 51 children aged 4 to 11 years old ($n_{ASD} = 25$, $n_{TD} = 26$) participated.
- 47 children had valid eye-tracking data for the Static Social Scenes paradigm ($n_{ASD} = 23$, $n_{TD} = 24$).
- Five ABC-CT collaborating implementation sites:
  - Yale University
  - University of Washington
  - University of California, Los Angeles
  - Duke University
  - Boston Children's Hospital

Table 1. Participant characterization means and standard deviations. Asterisks indicate significant group differences.

|  | ASD | TD |
|---|---|---|
| Participants | 25 | 26 |
| Participants with Valid Data | 23 | 24 |
| Males with Valid Data | 18 | 16 |
| Age (years) * | 8.0 (2.2) | 6.6 (2.0) |
| DAS-II FSIQ *** | 93.4 (18.3) | 115.2 (8.8) |
| DAS-II VIQ *** | 91.6 (20.6) | 116.2 (13.9) |
| DAS-II NVIQ *** | 95.0 (18.0) | 112.1 (7.4) |
| ADOS Calibrated Severity Score *** | 7.8 (1.6) | 1.2 (0.4) |
| ADOS SA Severity Score *** | 7.7 (2.1) | 1.4 (0.7) |
| ADOS RRB Severity Score *** | 7.3 (2.5) | 1.6 (1.6) |

DAS-II = Differential Ability Scales-II
ADOS = Autism Diagnostic Observation Schedule

## Procedure

- ABC-CT Feasibility was a two-day battery including:
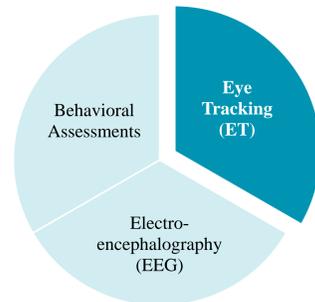


- Eye-tracker: 500 Hz SR EyeLink 1000 Plus.
- Full ABC-CT Feasibility ET battery: 9 paradigms.
- Current study looks at the Static Social Scenes ET paradigm, derived from the EU-AIMS Longitudinal Autism Project (LEAP) task battery (Loth et al., 2017).

## Stimuli

- Six static photographs (similar to Fig. 1a).
- Displayed for 20 seconds each with upbeat soundtrack.
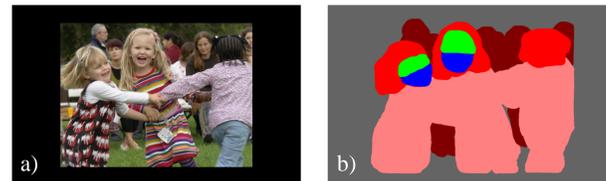- Interleaved with images from the Visual Search paradigm.



Figure 1. Screenshot of an image from the Static Scenes paradigm (a) and the corresponding image showing areas of interest (AOIs) for analysis (b). The green (upper face) and blue (lower face) regions comprise the face AOI used for analysis.

## Analysis

- Eye-tracking quality inclusion criteria:
  - Trials: > 50% on-screen looking and < 2.5 degrees of calibration error.
  - Participant: two or more valid trials (out of six total).
- Linear mixed models performed on trial-level data.
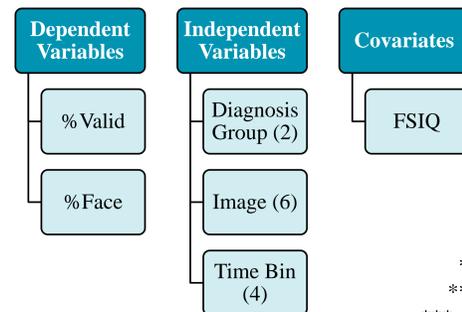


* = p < .05
** = p < .01
*** = p < .001

## Results

*Do participants with ASD and TD perform differently in this free-viewing task?*
- %Valid on-screen looking: ASD < TD ($p = .003$, $d = 1.6$).
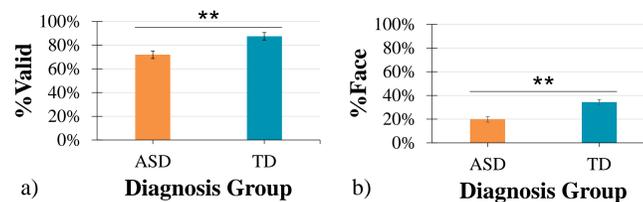- %Face: ASD < TD ($p < .001$, $d = 0.91$).



Figure 2. Diagnosis group differences in %Valid (a) and %Face (b).

*Do participants look at faces differently depending on the image?*
- Significant main effect of image ($p < .001$) and diagnosis by image interaction ($p = .032$).
- ASD group looked less at faces than TD group for all images ($p$'s < .05) except the image of a lone girl coloring (Fig. 3).
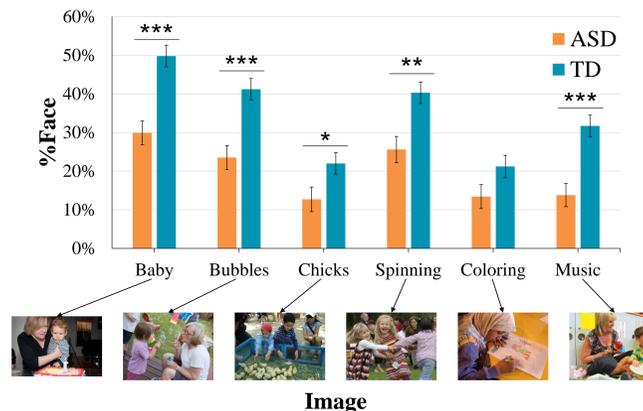


Figure 3. Diagnosis group differences in %Face for each image.

*Do participants watch less over time (within a trial)?*
- Between-group differences in %Valid increased over time (ASD < TD) while between-group differences in %Face were relatively consistent throughout (Fig. 4).
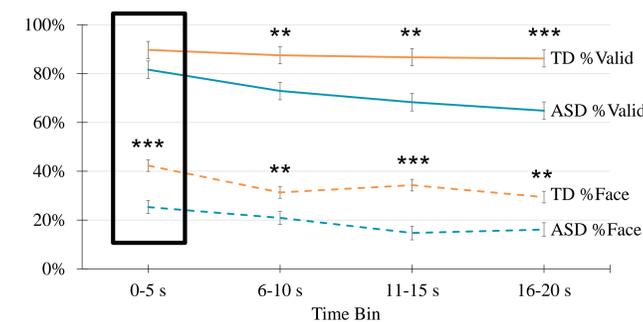


Figure 4. Diagnosis group differences in %Valid and %Face over the course of an image's presentation, broken into 5-second bins.

## Results Continued

*How does presentation time affect group differences in %Valid or %Face?*

Table 2. Presentation time vs. %Valid and %Face Cohen's d values for group differences (ASD vs. TD).

The strongest between-group difference in %Face was seen for 0 - 5 seconds, when no between-group difference exists for %Valid (Fig. 4).

| Presentation Time | %Valid Cohen's $d$ | %Face Cohen's $d$ |
|---|---|---|
| 0 - 20 s | | 1.56 | 1.26 |
| 0 - 10 s | | 0.86 | 1.00 |
| **0 - 5 s** | | **0.50** | **1.31** |
| 0 - 3 s | | 0.46 | 0.85 |
| 0 - 2 s | | 0.48 | 0.65 |
| 0 - 1 s | | 0.49 | 0.80 |
| 0 - 0.5 s | | 0.45 | 0.61 |

## Conclusions

- Eye-tracking during static social images revealed face preference differences between children with and without ASD.
- Increased social complexity may increase group differences.
- Face-looking differences appear as early as the first second of presentation, meaning that shorter trials may be sufficient for between-group differentiation.
- First five seconds:
  - Largest between-group difference in face preference.
  - No between-group differences in overall looking.
  - Suggests that the difference in overall attention is separable from the difference in social attention.

## References

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