The relationship between ADHD symptoms and looking patterns in children with ASD: Results from the Autism Biomarkers Consortium for Clinical Trials (ABC-CT)

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Background

- Children with autism spectrum disorder (ASD) have high rates of co-occurring attention deficit/hyperactivity disorder (ADHD).[1]
- Children with ASD and ADHD may experience social, adaptive, and cognitive challenges.[2]
- In ASD and in ADHD, social visual attention represents a possible shared pathway of underlying mechanisms.[3]
- It is important to understand how ADHD influences social motivation and social preferences in ASD to inform future research and interventions.[4]

Objective:
Examine the relationship between ADHD symptomatology and social attention among autistic children.

Methods

ABC-CT Study Details:
- Multi-site, longitudinal study aimed at developing objective and reliable biomarkers of social functioning in ASD.
- Large sample (N = 399) of children with and without ASD were evaluated across 6 months through clinical assessments, electroencephalogram (EEG), and eye-tracking.

Inclusion/Exclusion Criteria:
- Ages 6-11.
- ASD diagnoses confirmed via Autism Diagnostic Observation Schedule (ADOS-2), Autism Diagnostic Interview-Revised (ADI-R), and clinician endorsement of DSM-5 criteria for ASD.
- FSIQ: 60-150 measured via Differential Ability Scales (DAS-II).
- Stable medication for 8 weeks.
- Children without sensory or motor impairments, epilepsy, and genetic or neurological conditions.
- Children with ADHD only (as assessed by the Child and Adolescent Symptom Inventory, 5th edition) were excluded from the larger study and not included in the analyses.

Participants	n	Age (SD)	FSIQ (SD)
ASD Males	206	8.64 (1.65)	95.46 (18.40)
ASD Females	65	8.33 (1.59)	101.61 (15.46)

Table 1. Participant demographics

Clinical Measures:
- *Child and Adolescent Symptom Inventory, 5th Edition (CASI-5)*
  - Parent-reported behavior rating scale for DSM-5 emotional and behavioral disorders in children.
  - CASI-5 Inattentive T-score and Hyperactive-Impulsive T-scores were used to characterize ADHD symptoms in children.

Eye-tracking Acquisition
- Binocular eye-tracking data were collected at 500 Hz using a SR Eyelink 1000 Plus.

Methods, cont.

Eye-Tracking Experiment
- Participants were presented with 6 20-second trials of 5 images equidistant from the center of the screen (Figure 1).
- Latency to fixate to each object was calculated as the time when the gaze first entered the pre-defined region of the object.
- Percent looking was calculated as the number of valid gazes to the object divided by the total number of onscreen gaze samples.
- Average looking time was calculated as time spent looking at the object divided by the total presentation time.

Figure 1: Trials were presented as full-color circular arrays of a face with direct gaze, scrambled face, bird, mobile phone, and car that were matched for color, size, and luminosity.

Statistical Analyses:
- Relationships among ADHD symptoms (CASI-5 Inattentive subscale and Hyperactive-Impulsive subscale T-scores), latency, percent looking, and average looking time during the visual search paradigm were analyzed with regression analyses.

Results

- Inattentive and hyperactive-impulsive symptoms were positively correlated with the latency of the first look to faces (r = 0.14, p < 0.03 for inattentive symptoms; r = 0.15, $p < 0.02$ for hyperactive-impulsive symptoms; Figure 2a, 2b), but not with nonsocial objects (r = -0.06, $p = 0.36$; r = -0.11, $p = 0.06$, respectively).
- Inattention was negatively correlated with percent looking at faces (r = -0.17, p < 0.01) and average looking time (r = -0.15, $p < 0.02$; Figure 2c, 2d), but hyperactivity was not (r = -0.09, $p = 0.15$; r = -0.09, $p = 0.13$ respectively).

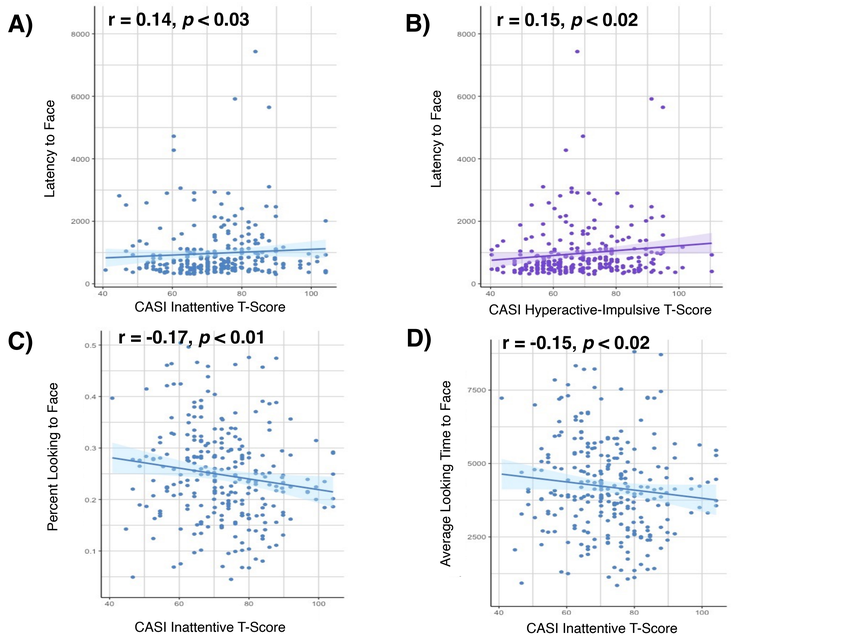

Figure 2. A) Relationship between latency to face and CASI Inattentive T-Score, B) Relationship between latency to face and CASI Hyperactive-Impulsive T-Score, C) Relationship between percent looking to face and CASI Inattentive T-Score, and D) Relationship between average looking time to face and CASI Inattentive T-score.

Results, cont.

- Percent looking to nonsocial objects increased with greater ADHD symptoms (r = 0.13, $p = 0.04$ for inattentive symptoms; r = 0.18, $p < 0.03$ for hyperactive-impulsive symptoms) (Figure 3a, 3b).
- Average looking time to nonsocial objects was also positively correlated with higher ADHD symptoms (r = 0.13, $p = 0.04$ for both inattentive and hyperactive symptoms; Figure 3c, 3d).

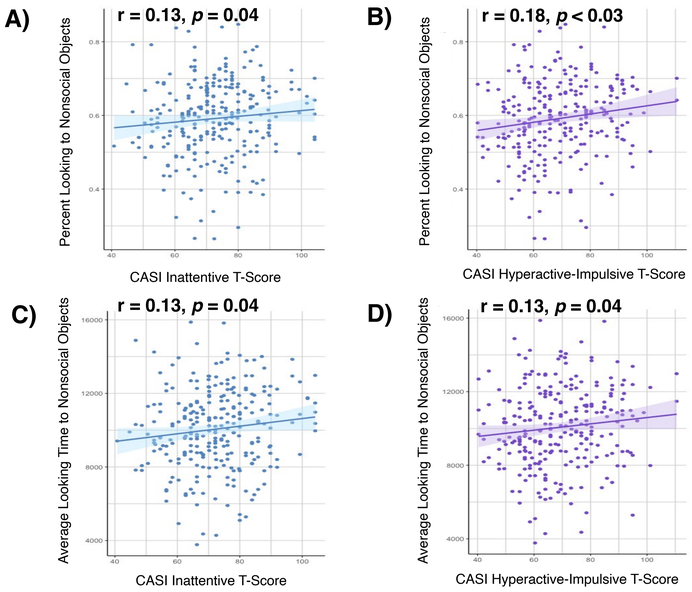

Figure 3: A) Relationship between percent looking to nonsocial objects and CASI Inattentive T-Score, B) Relationship between percent looking to nonsocial objects and CASI Hyperactive-Impulsive T-Score, C) Relationship between average looking time to nonsocial objects and CASI Inattentive T-Score, and D) Relationship between average looking time to nonsocial objects and CASI Hyperactive-Impulsive T-Score.

Discussion

- These findings indicate a relationship between ADHD symptomatology and looking patterns towards faces and nonsocial objects in autistic children.
- Higher ADHD symptoms were associated with greater latency to faces, and higher inattentive symptoms were associated with reduced looking to faces.
- In the context of prior research, results suggest that individuals with ASD and ADHD exhibit less looking to faces than individuals with ASD or ADHD alone, suggesting an interaction effect in which ADHD exacerbates social visual attention difficulties in ASD.
- Understanding these relationships may help inform the impact of psychiatric co-occurring conditions on the experiences and treatment needs of individuals with ASD.

References

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