



Relationships between Executive Function and Activity Monitoring in Children with ASD: Results from the ABC-CT Interim Analysis

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Introduction

Background

- The Autism Biomarkers Consortium for Clinical Trials (ABC-CT) aims to identify and validate biomarkers
- Gaze patterns toward social scenes found between children with Autism Spectrum Disorder (ASD) and typically developing (TD) individuals¹
- Executive Functioning (EF) deficits, common in ASD, often impact daily living skills and may also contribute to the core socio-communicative deficits of ASD^{2, 3, 4}
- The current study evaluates the impact of EF ability on eye-tracking (ET) outcomes using the Activity Monitoring paradigm

Hypotheses

- Looking at heads (%Head) and the scene overall (%Total) would be correlated with parent-rated EF ability
- Children with ASD would look at heads less than TD children
- After controlling for IQ and diagnosis group, EF would have an effect on %Head
- Group differences in %Head would be stable across time points

Methods

Participants

- 223 children ages 6 to 11 ($N_{ASD} = 159$, $N_{TD} = 64$) participated in the ABC-CT Main Study (Table 1)

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

	ASD	TD
Total Participants	159	64
Age (years)	8.7 (1.6)	8.7 (1.8)
Sex (Males)	131	42
DAS-II VIQ *	96.4 (18.9)	115.9 (12.2)
DAS-II NVIQ *	97.1 (17.8)	110.8 (13.8)
DAS-II Abbr. IQ *	95.8 (18.9)	114.6 (13.5)
ADOS-II Calibrated Severity Score *	7.6 (1.8)	1.8 (1.3)
ADOS-II SA Severity Score *	7.6 (1.8)	1.8 (1.2)
ADOS-II RRB Severity Score *	7.9 (2.0)	2.6 (2.3)
CASI-I T-Score *	71.3 (12.5)	47.7 (7.5)
CASI-HI T-Score *	67.9 (13.9)	46.5 (7.1)

ADOS = Autism Diagnostic Observation Scale; DAS-II = Differential Ability Scale; CASI-HI = Child and Adolescent Symptom Inventory Hyperactive-Impulsive, CASI-I = Inattentive

Procedure

- Data was collected from five sites (BCH, Duke, UW, UCLA, Yale) at three time points. (Figure 1)

- An Eyelink 1000 Plus 500 Hz was used to track gaze



Activity Monitoring (AM) Paradigm⁵

- One of six paradigms in full ET battery
- 20 second videos and images (8 total) depicting two actresses engaged in a shared activity (Figure 2, 3)
- Distractor objects placed throughout scene
- Two gaze conditions: activity or other actress



Figure 2. Example still of the AM stimuli (gaze condition: activity).

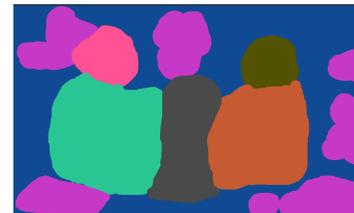


Figure 3. Corresponding areas of interest (AOIs) for Figure 2.

Analysis

- Dependent variables: percent of time spent looking at actresses' heads (%Head), the background or distractor objects (%Background), the shared activity (% Activity), and ratio of valid looking time (%Total) (Figure 3)
- Trial inclusion criteria: valid data > 50%, calibration error < 2.5°

Results

Is EF related to %Head or %Total?

- Pearson's correlations revealed relationships between %Head and CASI-I & CASI-HI only in the ASD group (Table 2). After controlling for IQ, these relationships were preserved

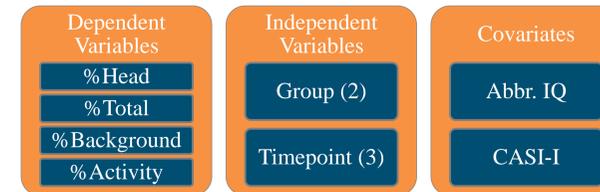
Table 2. Pearson's correlations between %Head, %Total and CASI-5 subscales. Rows outlined in orange represent values after controlling for IQ.

	%Head			%Total		
	All	ASD	TD	All	ASD	TD
%Head	--	--	--	--	--	--
%Total	.29**	.15*	.26**	--	--	--
CASI-I	-.41***	-.13	.09	-.21**	.03	-.15
CASI-HI	-.43***	-.22**	.04	-.25***	-.12	.16
CASI-I	-.36***	-.14 ^a	.09	-.15*	-.01	-.16
CASI-HI	-.39***	-.22*	.03	-.20**	-.13	.18

* $p < .05$, ** $p < .01$, *** $p < .001$

Do group differences in gaze patterns exist when controlling for IQ and EF ability?

- Linear Mixed Model examining %Head averaged across time point



- %Head:** all effects and interactions significant, including the 3-way interaction between group, IQ, and CASI-I, $F(223, 1) = 5.51$, $p = .02$
- %Total, %Background, and %Activity:** No effects or interactions

How do IQ and EF impact the relationship between group and %Head?

- To interpret the group*CASI*IQ interaction, we examined effects at group averages of IQ and CASI-I (Figure 4)
- Significant group differences were found at each IQ/CASI level. The greatest between group difference emerged when CASI and IQ were set to ASD group averages

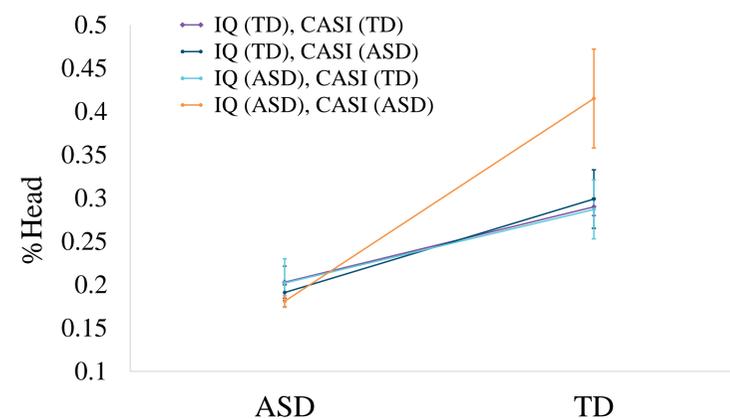


Figure 4. Group means in %Head set at varying IQ/CASI. SE used for error bars.

Do group differences in %Head change over time?

- No group differences at **T2**, $F(218, 1) = .18$, $p > .05$, or **T3**, $F(218, 1) = .70$, $p > .05$.
- Repeated measures ANCOVA (%Head ~ Group*Timepoint*IQ*CASI-I) did not reveal a significant interaction, $F(218, 2) = 1.78$, $p > .05$ (Figure 5)

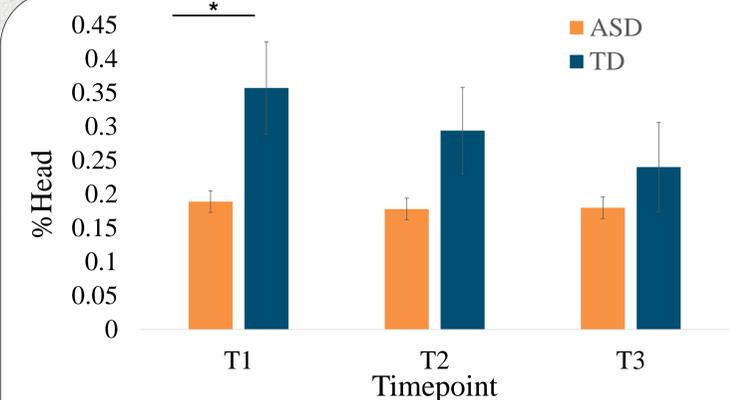


Figure 5. Estimated marginal means from a repeated measures ANCOVA examining %Head in ASD and TD children with IQ and CASI-I as covariates.

Conclusions

- Consistent with our first hypothesis, EF ability was related to %Head in the sample overall. When broken down by group, this pattern only remained in ASD
- As predicted in our second hypothesis, TD children looked at the heads more than kids with ASD, regardless of IQ or CASI scores
- We did not see the predicted effect of EF on %Head in either group. However, when poor EF was paired with lower IQ in the TD group, %Head significantly increased, while %Head in the ASD group remained the same
 - Decreased EF and IQ may have underscored a core between-group difference in social motivation. When TD kids were not looking at the expected targets, they appeared to be drawn to the social facets of the stimuli
- In contrast with our third hypothesis, when controlling for IQ and EF, group differences in %Head decreased after each time point

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