



Spontaneous Social Orienting in School-Age Children with ASD: Results from the ABC-CT Feasibility Study



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Introduction

Children with ASD show limited attention to faces during the prodromal [1-3] and early syndromal stages of the disorder in comparison to typically developing (TD) and developmentally delayed children (DD) [4-7]. These deficits are context dependent and most pronounced when children observe a person trying to engage their attention using eye contact and speech [4,8,9], but not when a person engages in a solitary activity where neither eye contact nor speech are present, [4] or when perceptually salient dynamic distractors are included [4,10]. The Selective Social Orienting (SSO) [4] task has been found to discriminate infants and toddlers with ASD from controls [2,4], to be associated with clinical features, and to subtype the toddlers into clinically-meaningful subgroups [11]. It is not clear, however, if the task also constitutes a promising biomarker for school-age children.

Objectives

To examine (1) feasibility of SSO task, (2) between group differences, and (3) associations with clinical phenotypes in school-age children with ASD and typically developing (TD) controls.

Methods

The SSO, a free-viewing eye-tracking task, consists of four conditions in which an actress engages viewer's attention using direct eye contact and speech (Dyadic Bid), initiates acts of joint attention using gaze and speech cues (JA), performs an activity (Sandwich), or looks at moving animal toys (Animal). Dependent measure was a proportion of time looking at the face standardized by the overall looking time at the scene (%Face). Data were analyzed using linear mixed models (unstructured covariance matrix; LMM) with diagnosis and condition as factors and full scale IQ (FSIQ) as a covariate. Associations between %Face and severity of autism symptoms, verbal and nonverbal IQ and SRS-2 T scores in the ASD group were examined with age as a covariate.

	ASD	TD
Participants with Analyzable Data	25	26
Participants with Valid Data	23	26
Age at Enrollment (years)	7.77 (2.30)	6.60 (1.98)
FSIQ	91.08 (19.51)	114.08 (9.34)
VIQ	89.40 (21.38)	115.23 (13.79)
NVIQ	92.84 (19.03)	111.04 (8.03)
ADOS-2 Calibrated Severity Score	7.84 (1.57)	1.19 (0.40)
ADOS-2 SA Severity Score	7.76 (2.05)	1.38 (0.70)
ADOS-2 RRB Severity Score	7.36 (2.43)	1.69 (1.69)

Table 1: Participant Characterization

Hypotheses

Feasibility: SSO task will be well tolerated and successfully completed by a vast majority of ASD and TD participants.

Discrimination biomarker: ASD and TD groups will differ in %Face in conditions that include gaze cues and speech, i.e., the Dyadic Bid and JA but not in Sandwich and Animal conditions.

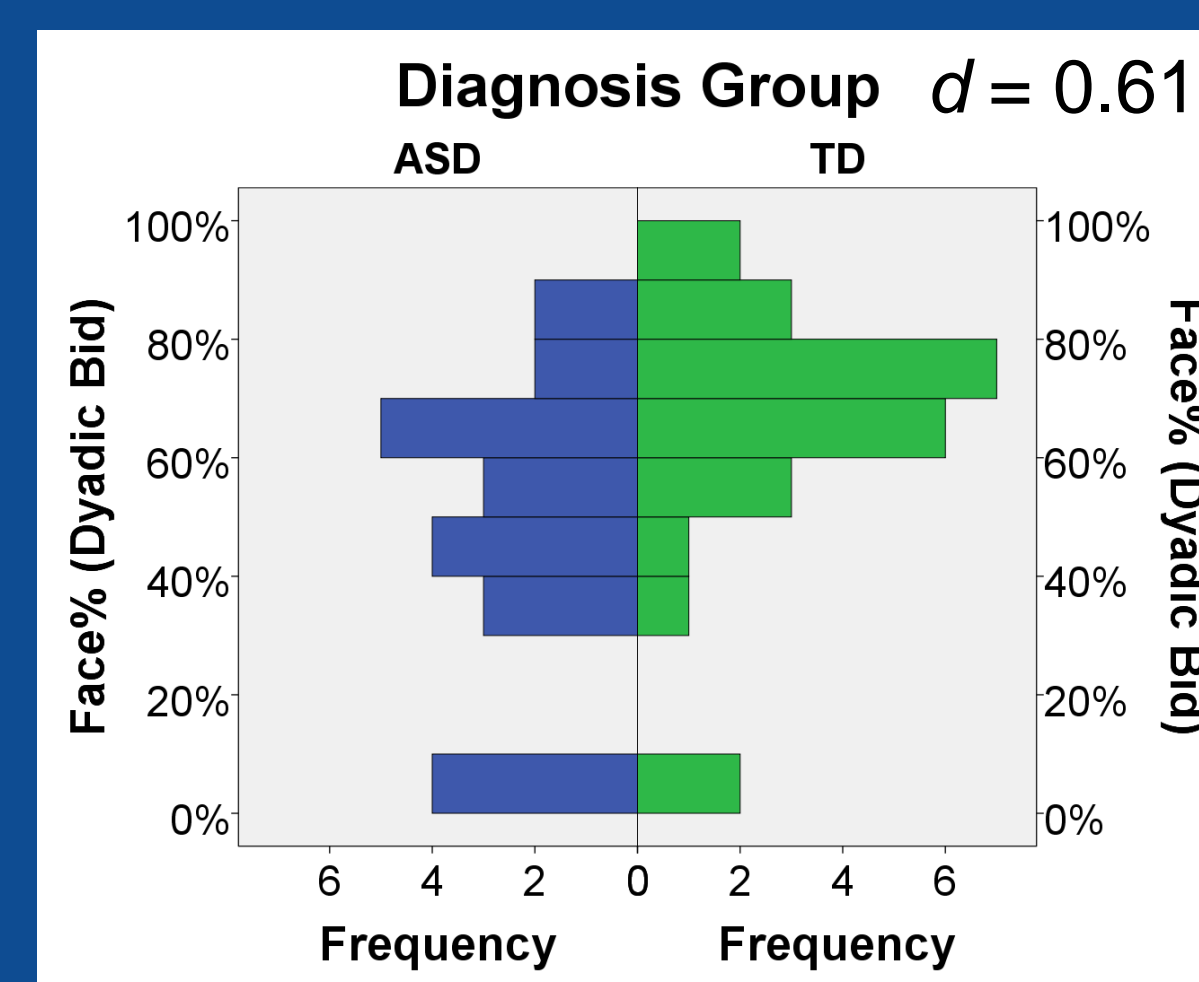
Correlation with clinical features: In an exploratory manner, we evaluated associations between %Face and severity of autism symptoms, VIQ and NVIQ, and SRS-2 T scores.

Results

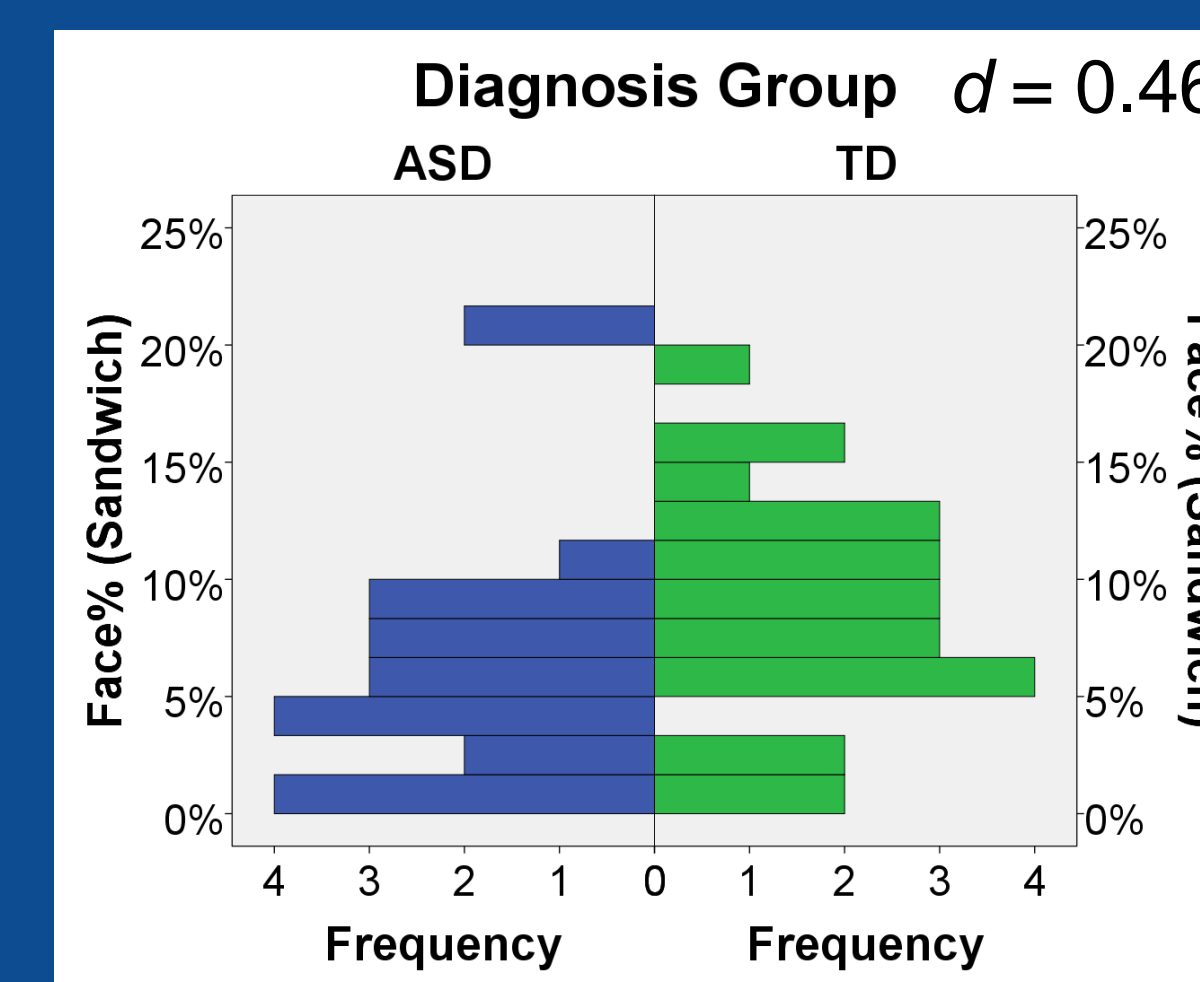
Feasibility. Valid eye tracking data were collected from 23/25 (92%) children with ASD and 25/26 (96.3%) TD controls ($p = .342$).

Discrimination Biomarker. A LMM on %Face indicated a significant effect of group, $F(1, 42.04) = 7.46, p = .009$ as well as condition, $F(3, 36.68) = 56.47, p < .001$, and a significant condition x group interaction, $F(3, 36.68) = 5.66, p = .003$. The effect of FSIQ was also significant, $F(1, 39.09) = 12.73, p < .001$.

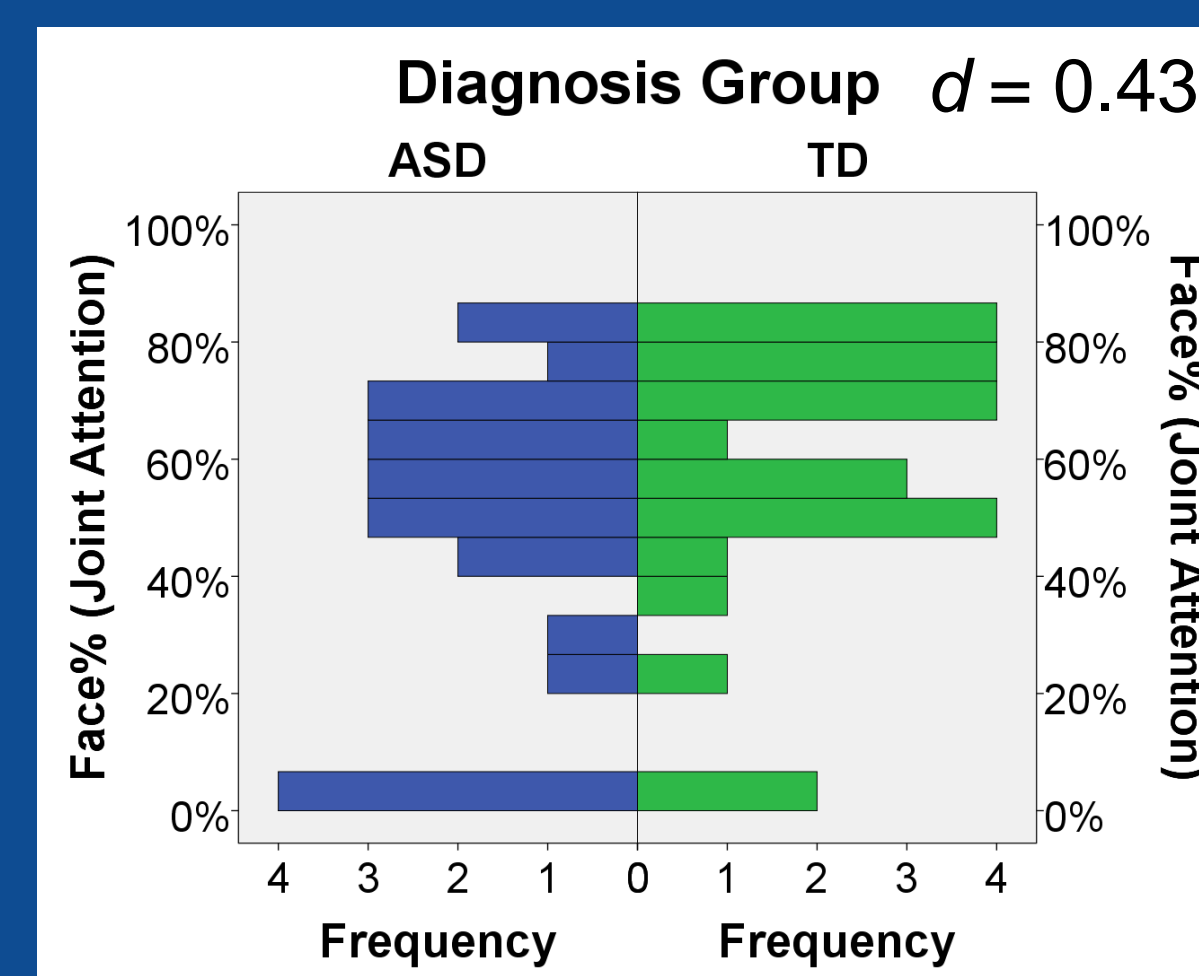
Across all conditions, children with ASD had lower %Face than TD controls (Cohen's $d = .61$). The groups did not differ in the Sandwich ($p = .860$) and Animal ($p = .099$) conditions, but children with ASD had lower %Face in the Dyadic Bid ($p < .001$, Cohen's $d = .61$) and JA ($p = .018$, Cohen's $d = .42$) conditions (see Figure 1).



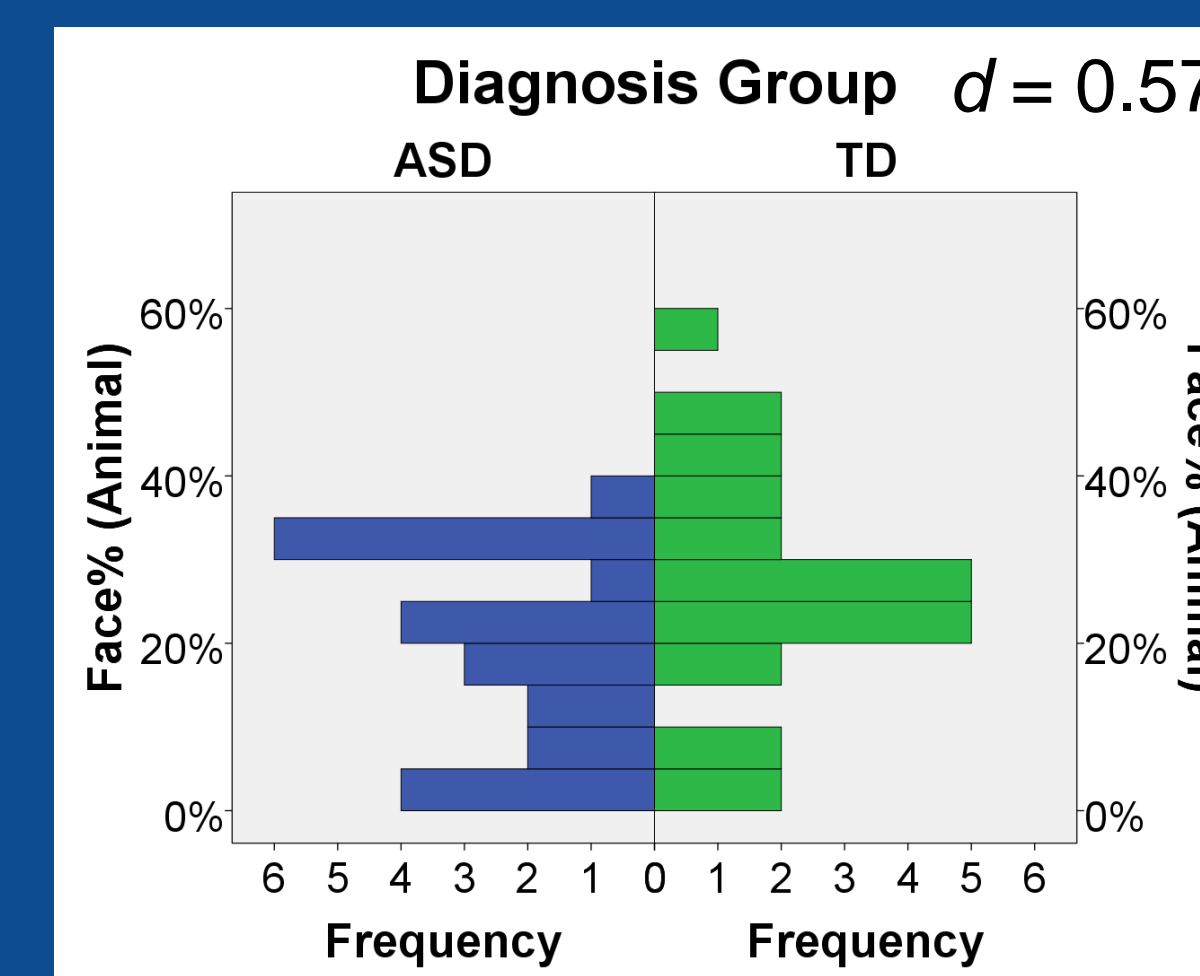
%Face (Dyadic Bid)	Whole Sample	TD	ASD
Valid data	48 / 51 (94.1%)	25 / 26 (96.2%)	23 / 25 (92.0%)
Mean	56.3%	63.5%	48.5%
SD	25.3%	23.2%	25.7%
Skew	-1.1	-1.7	-0.7
Kurtosis	0.4	3.0	-0.3



%Face (Sandwich)	Whole Sample	TD	ASD
Valid data	46 / 51 (90.2%)	24 / 26 (92.3%)	22 / 25 (88%)
Mean	7.8%	9.0%	6.6%
SD	5.3%	4.9%	5.6%
Skew	0.6	0.0	1.4
Kurtosis	0.2	-0.2	2.2



%Face (Joint Attention)	Whole sample	TD	ASD
Valid data	48 / 51 (94.1%)	25 / 26 (96.2%)	23 / 25 (92.0%)
Mean	53.0%	58.2%	47.3%
SD	25.3%	23.7%	26.3%
Skew	-0.93	-1.22	-0.74
Kurtosis	-0.03	1.09	-0.52



%Face (Animal)	Whole sample	TD	ASD
Valid data	48 / 51 (94.1%)	25 / 26 (96.2%)	23 / 25 (92.0%)
Mean	23.7%	27.4%	19.6%
SD	14.1%	15.0%	12.1%
Skew	0.10	-0.03	-0.18
Kurtosis	-0.25	-0.07	-1.20

Figure 1: Frequency distribution for %Face in ASD and TD groups

Results Continued

Correlations with clinical phenotypes: In the ASD group, %Face in all conditions combined was associated with SRS-2 Social Awareness ($r(19) = -.47, p = .034$), Social Cognition ($r(19) = -.57, p = .007$), and Social Communication ($r(19) = -.38, p = .091$) T scores, as well as with VIQ ($r(19) = .45, p = .030$), and NVIQ ($r(19) = .45, p = .039$) scores. The association with severity of autism symptoms was not significant ($r(19) = .088, p = .708$) (see Figure 2).

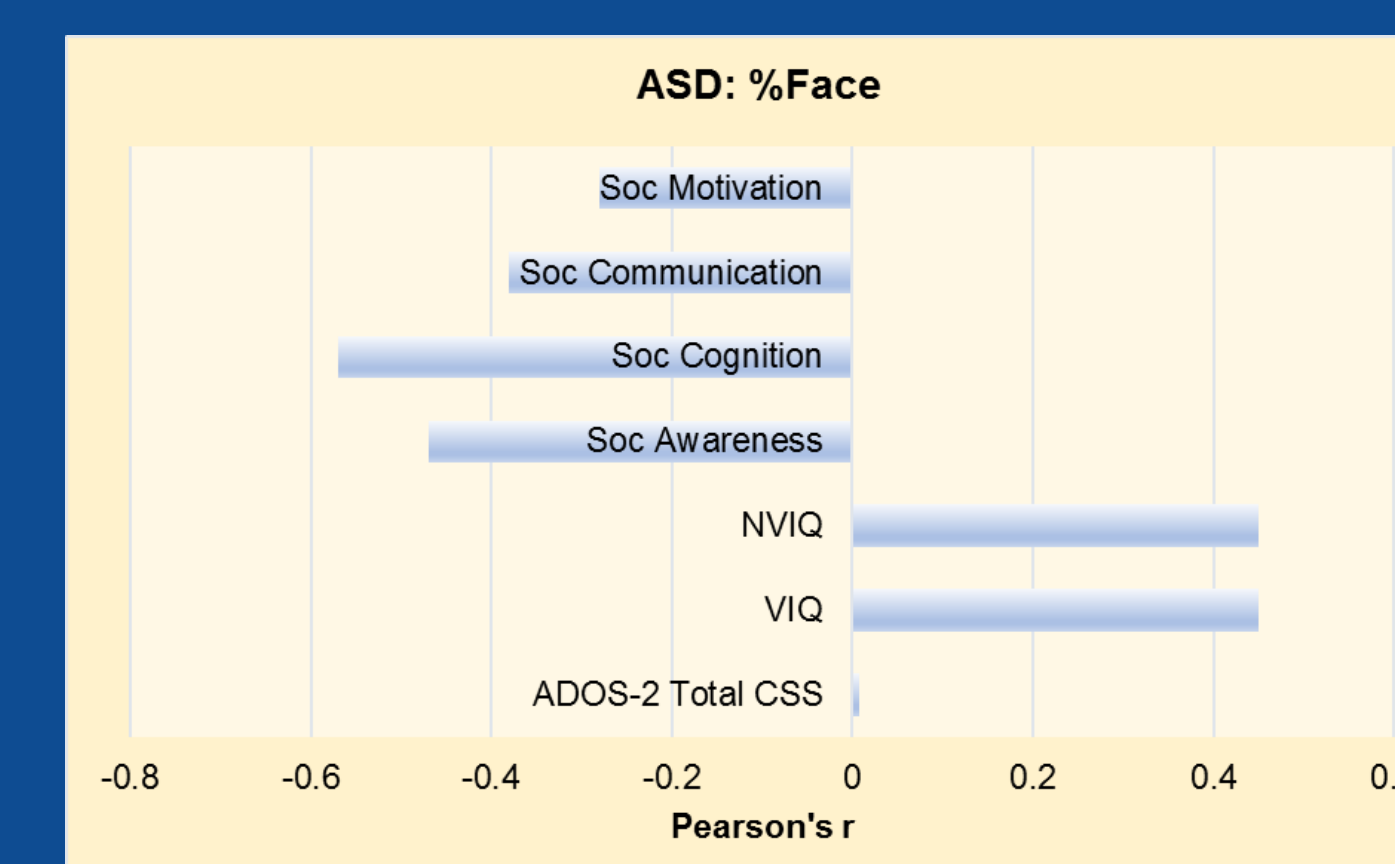


Figure 2: Pearson's r correlation coefficient between %Face and autism severity (ADOS-2 and SRS-2 measures)

Conclusions

The SSO task is highly feasible in school age children with ASD with IQ ranging from 53 to 123. Similar to infants and toddlers with ASD, school-age children with ASD showed poor attention to faces of interactive partners when gaze cues and speech cues were present, with medium effect sizes. Lower attention to faces was associated with poor social awareness and social cognition levels, as well as verbal and nonverbal IQ. This study, combined with prior work [2,4], suggests social orienting to faces emulating dyadic exchanges, generally, and the SSO task, specifically, may represent promising candidate biomarkers for ASD from infancy through school-age.

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Acknowledgements: We thank the clinicians, staff, and families without whom this work would not be possible. Support for this project was provided by the Autism Biomarkers Consortium for Clinical Trials (U19 MH108206, McPartland). Additional contributions include the ABC-CT statistical core of the DAAC, staff at the Data Collection Sites (Yale University, UCLA, Boston Children's Hospital/Harvard University, University of Washington, and Duke University), ABC-CT Project Management Staff, and the Data Coordinating Core.

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