

Linking Eye Gaze to Communication: A Comparison of Verbal and Minimally Speaking Children with Co-Occurring ASD and ID

I. Rodden, J. Momsen, A. Naples, J.M. Wolf, C.C. Cukar-Capizzi, C. Carrow, S. Eberle, J. McPartland

Background

- Autistic people show different gaze patterns to naturalistic social targets than neurotypical individuals, specifically through reduced attention to social content such as eyes and faces.^{1,2}
- Greater attention to the mouth relative to the eyes is related to stronger language skills in autistic children, though a reduction in the mouth-to-eyes ratio was associated with increased language improvements in a longitudinal study.³
- However, prior eye-tracking research has rarely included individuals with co-occurring autism spectrum disorder (ASD) and intellectual disability (ID) [ASD+ID].^{4,5}
- As such, it is unclear how both language and cognitive impairment severity may be related to visual attention in children with ASD+ID.

Objectives

- Compare how verbal and minimally speaking (MS) children with ASD+ID differ in their eye-tracking patterns.
 - Investigate relationships between visual attention and clinical measures of receptive and expressive language.
- Hypothesis: We predicted that verbal status would be associated with increased looking time to socially relevant aspects of images (i.e., faces) relative to non-social information.

Methods

- Children (n=32) with ASD+ID between the ages of 3 and 17 (Table 1).
- ASD diagnoses were confirmed using the Autism Diagnostic Observation Schedule, Second Edition (ADOS-2), Autism Diagnostic Interview-Revised (ADI-R), and DSM-5 criteria.
- ID diagnoses were confirmed through cognitive testing using the Differential Abilities Scales-II or the Mullen Scales of Early Learning.
- Adaptive communication skills were measured using the Vineland Adaptive Behavior Scales, Third Edition (Vineland-3) interview.
 - The Vineland-3 yielded an overall Adaptive Behavior Composite (ABC) score as well as domain scores (communication, daily living skills, and socialization).
- Expressive verbal status (binarized as verbal or MS) was based on clinician assessment on the ADI-R algorithm.
 - MS was defined as producing functional phrases with fewer than three-words spontaneously.

Table 1. Participant Demographics

	MS	Verbal	p
n (female)	16 (3)	16 (2)	
Age	9.39 (4.27)	12.34 (4.57)	.069
Full-scale IQ	23.44 (10.53)	39.26 (16.54)	.003
Vineland-3 ABC	36.19 (11.08)	48.81 (18.38)	.025
ADI-R Total Score	13.88 (4.26)	18.94 (4.45)	.003
On Screen Sample Count	3259.45 (1347.75)	4618.27 (1271.48)	.006

Note. Mean (SD) values reported. Group differences were tested through independent samples t-tests.

- Binocular remote eye-tracking data was collected at 500 Hz using an SR Research EyeLink 1000+ eye tracker.
- After calibration, participants viewed static scenes featuring children or children and adults engaging in solitary or social-interactive activities (Figure 1).

Figure 1. Example Eye-tracking Stimuli and Designated ROIs



Note. Stimuli images are on the left and maps of designated regions of interest (ROIs) are on the right. ROIs included parts of the face (i.e., eyes and mouths in green and blue), as well as any non-social elements in each image (e.g., objects in the background in grey).

- Visual attention variables were calculated by dividing the number of samples directed at a specific ROI by the total number of valid, on-screen samples, yielding percentage values that account for data quality.

Results

Group Differences in Attention

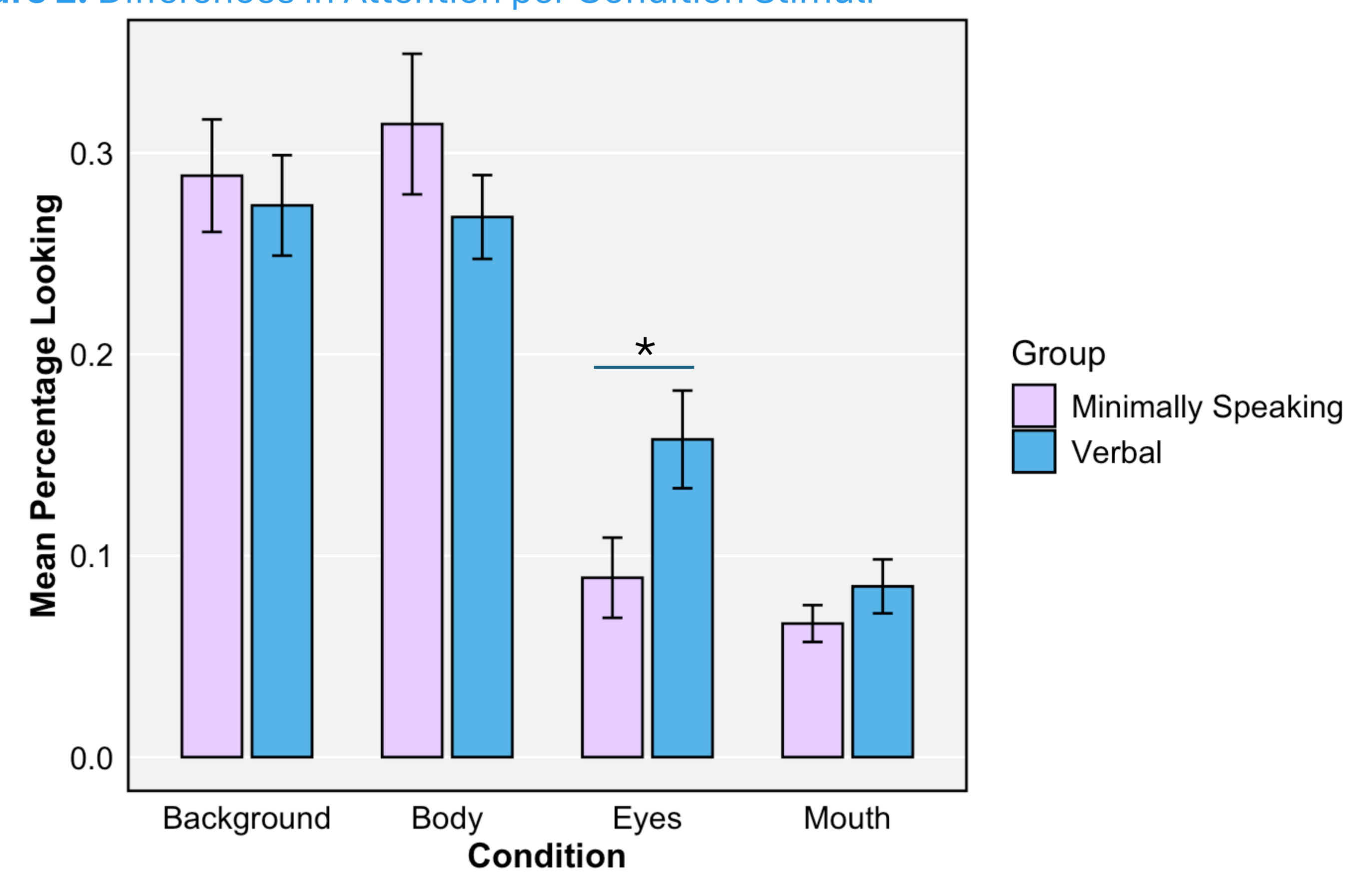
- An independent samples t-test indicated a significant difference between clinical groups wherein verbal children looked more at eyes than MS children ($t(28.3)=-2.18, p=.037$) (Table 2, Figure 2).
- This remained true in a one-way ANOVA that incorporated age as a covariate ($F(1, 28)=4.75, p=.038$).
- By contrast, visual attention to mouths ($p=.265$), bodies ($p=.267$), and to the image background ($p=.696$) was not associated with verbal status.

Table 2. Looking Percentages per Condition Stimuli

	MS	Verbal
Attention to eyes	8.91 (1.99)	15.78 (2.43)
Attention to body	31.44 (3.49)	26.82 (2.08)
Attention to mouth	6.63 (0.91)	8.45 (1.34)
Attention to image background	28.87 (2.79)	27.40 (2.49)

Note. M (SD) values reported. Values represent the proportion (%) of eye-tracking samples falling within the ROI relative to the total number of valid samples.

Figure 2. Differences in Attention per Condition Stimuli

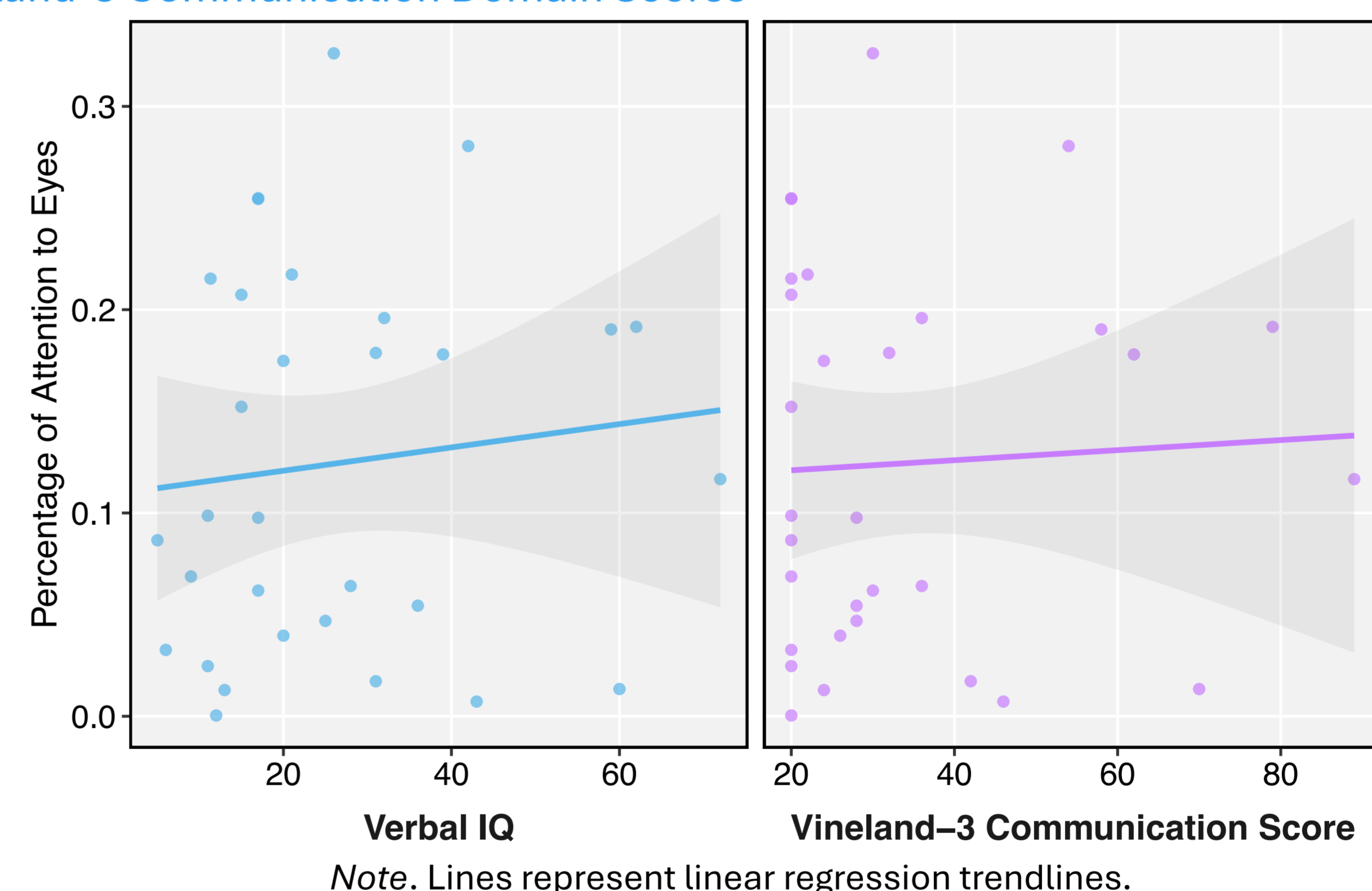


Note. * indicates $p < .05$. Error bars represent standard deviation values.

Relationships between Attention and Language Level

- Linear regression models showed that looking percent to eyes was not associated with measures of verbal IQ ($p=.561$) or scores on the Vineland-3 communication domain ($p=.786$) (Figure 3).

Figure 3. The Relationship between Proportion of Looking Time to Eyes with Verbal IQ and Vineland-3 Communication Domain Scores



Note. Lines represent linear regression trendlines.

Conclusions

- Our findings indicate that verbal and MS children with ASD+ID differ in their gaze patterns to social content, with verbal children exhibiting increased spontaneous attention towards eyes relative to MS children.
- However, continuous measures of receptive and expressive language skills did not associate with eye gaze, suggesting that social attention in children with ASD+ID may be driven more by categorical differences in expressive language ability than by domain-general communication skills.
- Future research should explore whether gaze patterns linked to language impairment severity reflect underlying differences in social-cognitive processing and how these patterns might relate to subtypes of ASD or to informing individualized interventions.

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