

Investigation of Autism Spectrum Disorder Diagnosis and Social Anxiety Symptoms as Predictors of Visual Attention to Faces and Eyes

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Background

- Up to 34% of adolescents with autism spectrum disorder (ASD) have co-occurring social anxiety (SA),¹ but this association has not been fully explored.²
- Eye-tracking (ET) provides an objective measurement of social attention that could clarify relationships between ASD and SA characteristics.
- In previous studies, individuals with ASD and individuals with SA both looked less at eyes than typically developing (TD) individuals; however, ASD participants also looked less at faces, while participants with SA showed an early attentional bias towards negative faces compared to neutral stimuli.^{3,4,5}

Objectives

- Investigate predictors of time spent looking at different facial regions of interest (ROIs), specifically whether (a) higher SA characteristics and (b) ASD diagnosis predict less time spent looking at eyes.
- Conduct exploratory analyses to look for relationships between ASD diagnostic group, SA score, stimulus valence, and time spent looking at ROIs.

Methods

Participants

Diagnostic Group	n (female)	Age in years (SD)	Full-Scale IQ (SD)
ASD	50 (12)	13.50 (2.83)	103.40 (18.82)
TD	34 (18)	12.51 (2.63)	109.15 (10.84)

Table 1. Participant demographics. ASD and TD participants did not significantly differ in age ($t=1.63, p>.05$) or full-scale IQ score ($t=-1.73, p>.05$), but the ratio of male-to-female participants did differ by diagnostic group ($X^2(1, N=84)=7.38, p=.007$).

Eye-Tracking Experiment

- Participants completed a gaze-contingent emotional faces ET paradigm with 80 trials per condition (Fig. 1).

Clinical Measures

- ASD diagnoses were confirmed using the *Autism Diagnostic Observation Schedule, Second Edition (ADOS-2)* and clinician endorsement of *DSM-IV* criteria for ASD.
- Cognitive ability was measured using either the School Age or Early Years battery of the *Differential Ability Scales, Second Edition (DAS-II)*.
- Participants completed the *Multidimensional Anxiety Scale for Children—Child Version (MASC-C)*, a self-report measure of anxiety symptoms.
- The *MASC-C* Social Anxiety (SA) subscale was used for the current analyses. Previous literature has validated the relationship between *MASC-C* SA scores and social phobia severity.⁶

Data Analysis

- ROIs were drawn for the face and eyes in Adobe Photoshop 2021.
- Percent looking time (%looking) at each ROI for happy and fearful faces was averaged across trials for each participant. Trials were included if participants looked onscreen at the emotional expression for at least 500 ms.
- %looking data was logit-transformed before analyses due to non-normality.
- Multiple linear regression analyses were performed to examine whether ASD group, SA score, and/or stimulus valence predicted %looking at ROIs.

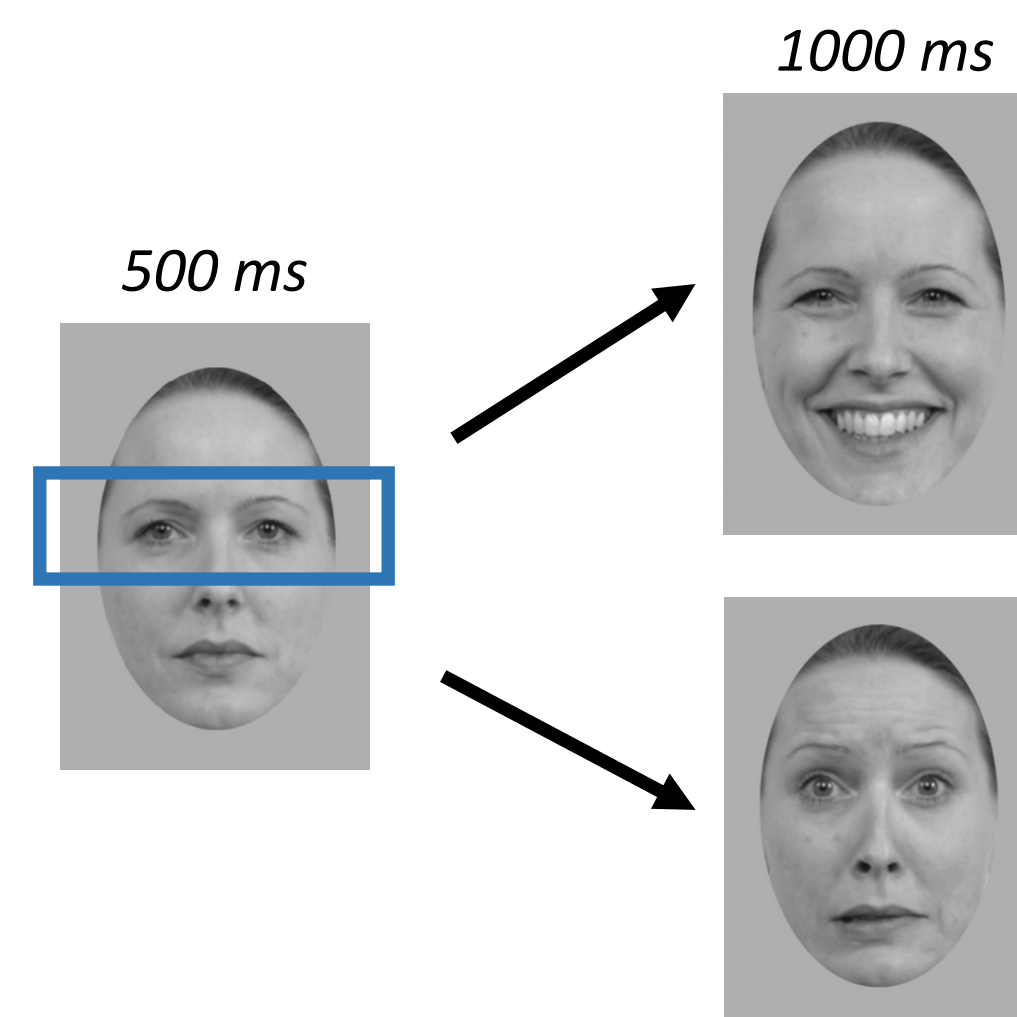


Figure 1. Gaze-contingent trial structure. Participants viewed a neutral face that shifted to a happy or fearful face after participants fixated on the eyes for at least 500 ms.

Results

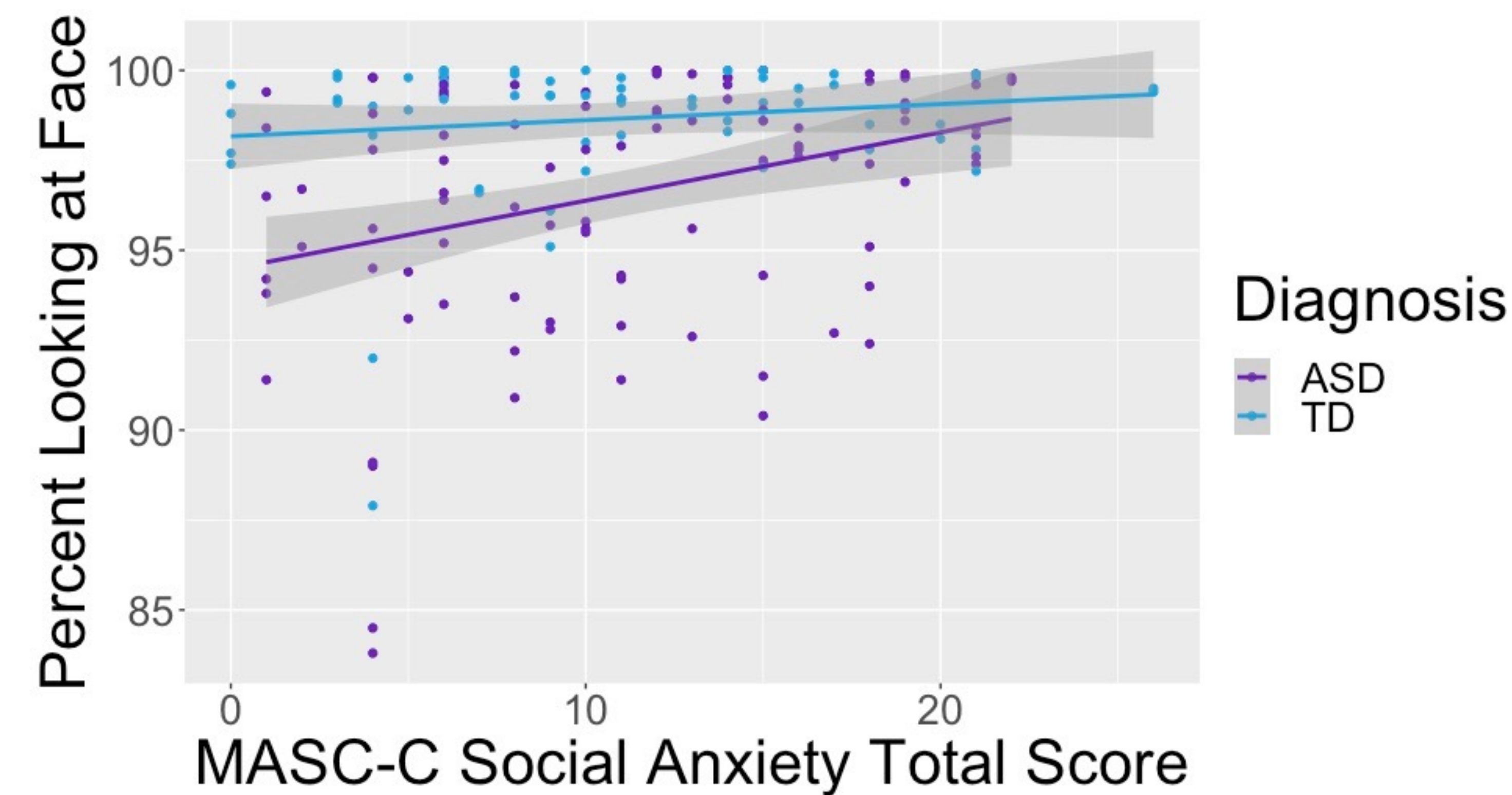


Figure 2. Percent looking at faces by MASC-C SA scores for children with ASD and TD. The overall linear regression model significantly predicted %looking at faces ($F(3,164)=13.08, p<.001, R^2=.18$). Children with ASD looked less at faces than TD children ($\beta=0.04, t(164)=4.12, p<.001$), children with higher SA scores looked more at faces than children with lower SA scores ($\beta<0.01, t(164)=4.10, p<.001$), and there was a significant group-by-SA interaction such that ASD participants with higher SA symptoms looked longer at faces than ASD participants with lower SA scores, a pattern not observed in TD participants ($\beta=-.002, t(164)=-2.04, p=.043$).

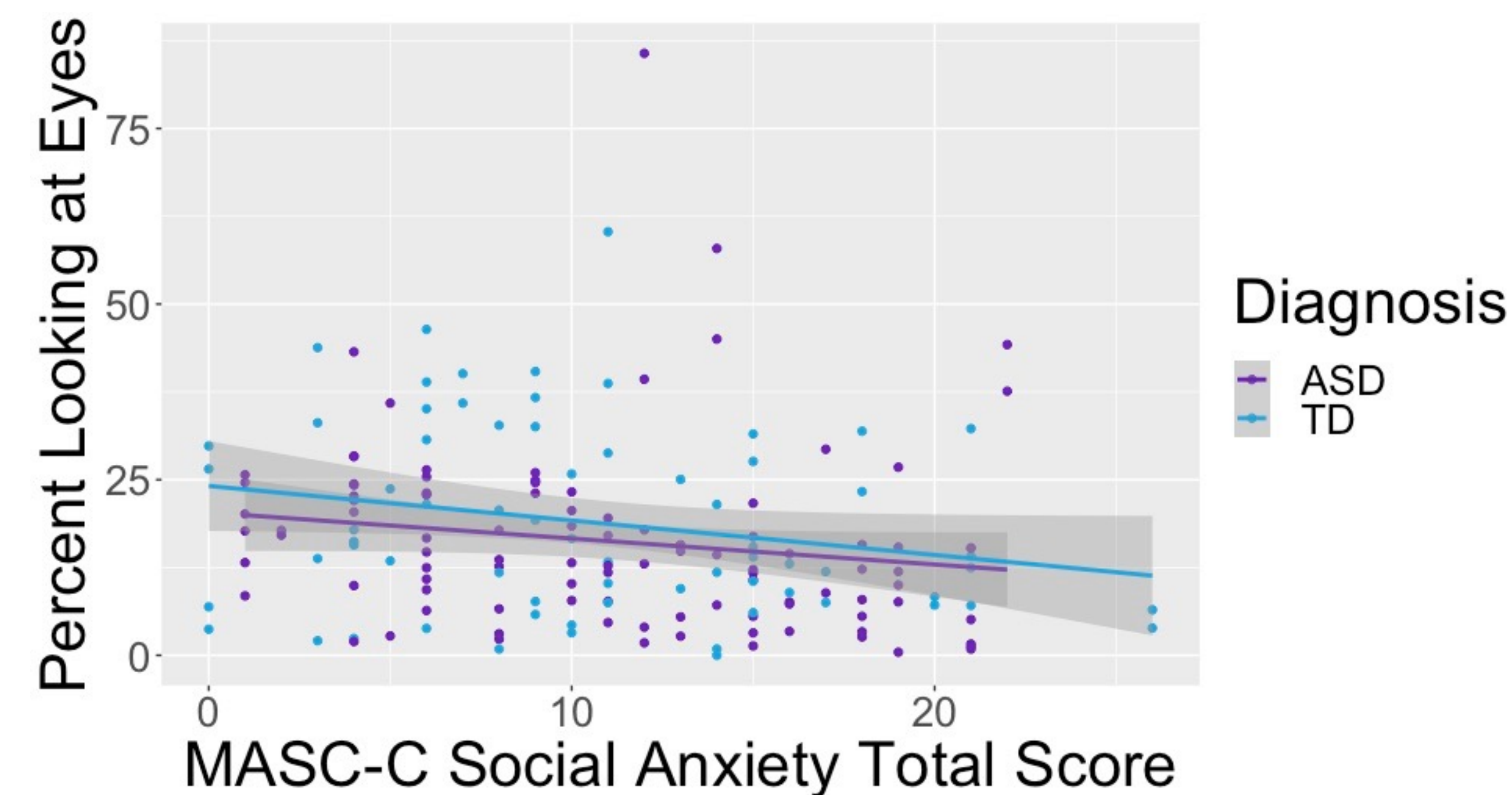


Figure 3. Percent looking at eyes by MASC-C SA scores for children with ASD and TD. The overall linear regression model was significant ($F(3,164)=3.23, p=.024, R^2=.04$). ASD diagnostic group did not significantly predict %looking at eyes, and there were no interaction effects (all $p>.05$); however, children with higher SA scores looked less at eyes than those with lower SA scores ($\beta=-.050, t(164)=-2.74, p=.007$).

- Stimulus valence was not a significant predictor in any regression model.
- Due to the interaction effect between SA scores and ASD diagnostic group for %looking at faces (Fig. 2), participants were divided into high SA ($N=62$) and low SA ($N=22$) groups using the clinically significant cutoff for *MASC-C* SA scores, 13.5.⁷ A two-way ANOVA was conducted to examine whether the relationship between ASD diagnostic group and %looking at faces differed at high and low levels of SA symptoms.

Results

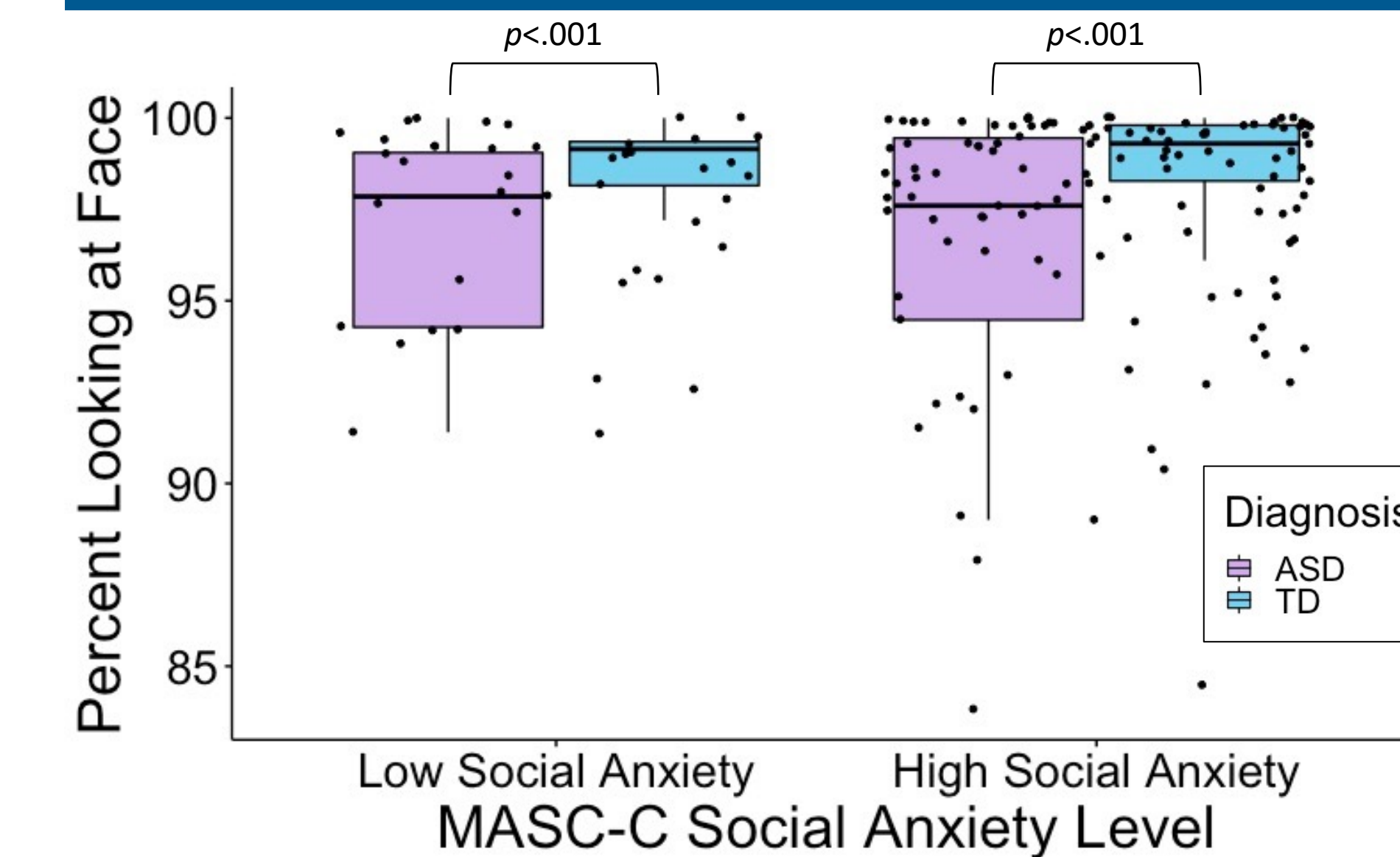


Figure 4. Percent looking at faces by high and low MASC-C SA scores for children with ASD and TD. Children with ASD looked less at faces than TD children at both high ($N=62$) and low ($N=22$) levels of SA symptoms ($F(1,164)=19.68, p<.001$). SA level was not significant, and there was no significant interaction between ASD diagnosis and SA level (all $p>.05$).

Conclusions

- Results indicated distinct contributions of SA and ASD characteristics to visual attention.
- Partially replicating previous findings, children with ASD looked less at faces than TD children, and children with higher SA scores looked less at eyes than those with lower SA scores; however, ASD diagnostic group did not predict time spent looking at eyes.
- Children with ASD looked more at faces when they had higher SA scores, which could indicate either increased social interest or increased hypervigilance to faces compared to children with ASD who have lower SA levels.
- Social anxiety symptomology was related to %looking at faces in children with ASD only when assessed dimensionally, not categorically. This could be due to the limited validity of the *MASC-C* SA clinical cutoff for social phobia (sensitivity = .63, specificity = .64).⁷
- Future studies should include additional SA measures and other predictor variables (e.g., sex, IQ score) to improve understanding of the relationships between ET data, ASD diagnostic group, SA symptomology, and other participant characteristics.

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