

The Multisensory Attention Assessment Protocol (MAAP): Indices of Attention Predict Diagnostic Status and Social-Communicative Functioning in Children with Autism Spectrum Disorders

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Background

Children with autism spectrum disorder (ASD) show impairments in social orienting, disengaging attention, and intersensory processing (Ames & Fletcher-Wilson, 2010; Bahrick & Todd, in press; Dawson et al., 2004) skills typically well-established during infancy. Intersensory processing organizes the typical development of attention and perception and provides the foundation for perceiving unified audiovisual events in infancy (Bahrick & Lickliter, 2002; Lewkowicz, 2000). Impairments in these early developing skills can negatively impact subsequent developments in joint attention and communication (Bahrick, 2010; Mundy & Burnette, 2005). A new measure, the Multisensory Attention Assessment Protocol (MAAP), assesses basic indices of attention (disengagement, orienting, maintenance, and intersensory processing) to dynamic audiovisual social and nonsocial events in a single protocol. Preliminary findings (Newell et al., 2007; Bahrick et al., 2010) indicate that children with ASD show longer latencies to disengage attention and reduced attention maintenance to social, but not nonsocial, events, as well as diminished intersensory processing when compared with typically developing (TD) children.

Objective

Our primary objectives were to develop the MAAP as an instrument for assessing fundamental attention skills and impairments in ASD and TD and to develop preliminary models for predicting diagnostic status and social-communicative functioning on the basis of performance by children with TD and ASD on three indices of attention (maintenance, disengagement, and intersensory processing) assessed by the MAAP. We evaluated the prediction that indices of attention would be significantly correlated such that high levels of intersensory processing would be associated with longer attention maintenance and lower latencies to disengage attention, and that this pattern would be particularly evident for social as compared with nonsocial events. Further, using structural equation modeling (SEM), we assessed the predictions that children who showed longer attention maintenance, lower latencies to disengage, and enhanced intersensory processing of social events would 1) be less likely to have a diagnosis of ASD (Diagnostic Status Prediction), and 2) show greater social-communicative functioning as indexed by more instances of initiating joint attention (IJA) for children with ASD (IJA/Social Functioning Prediction).

Methods

Sixteen TD children ($M = 2.42$ yrs, $SD = .85$) and 16 children with ASD ($M = 4.29$ yrs, $SD = .85$), 1.5-5.5 years of age, were matched for Mullen composite mental age (ASD: $M = 2.29$ yrs, $SD = 1.29$; TD: $M = 2.51$ yrs, $SD = 1.06$, $t(30) = .55$, $p = .97$). All children with ASD received a clinical diagnosis and met the cutoff for diagnosis on the ADOS, whereas no TD child met the cutoff. In the MAAP, trials of a central visual event (13s) were followed 3 s later by two side-by-side peripheral events (10s), with the natural soundtrack synchronized with one of the two events. Blocks (20 trials each) of social (affectively positive speech) and nonsocial events (objects striking a surface) were presented. Intersensory matching (percent of total looking time to the sound-synchronous peripheral event; PTLT), attention maintenance (percent of available looking time spent fixating the peripheral events; PALT), and disengagement (latency in seconds) to shift attention from the central stimulus to a peripheral event; RT Disengage) were assessed. Finally, children participated in the Early Social Communication Scales (ESCS; Mundy et al., 2003) and number of IJA instances was observed.

Results

As predicted, significant correlations among the three indices of attention (intersensory matching, PTLT; latency to disengage, RT Disengage; attention maintenance, PALT), as well as among PALT, diagnostic status, and IJA were found (Pearson $r_s > .36$, $p_s < .05$). We evaluated our Diagnostic Status and IJA/Social Functioning predictions by assessing their fit with two SEM models.

Diagnostic Status Prediction (Figure 1; $N=32$): It was expected that higher PTLTs and lower RTs to disengage would predict greater PALTs to social events, and greater PALTs to social events would predict diagnostic status (the likelihood that children would score below the ADOS cutoff). Indices of fit revealed no significant points of ill fit, $\chi^2(2) = 1.63$, $p = .44$. The variables in the model accounted for 13% of the variance in diagnostic status and 42% of the variance in attention maintenance and all of the path coefficients were statistically significant.

Figure 1. Static images of the dynamic stimulus events.

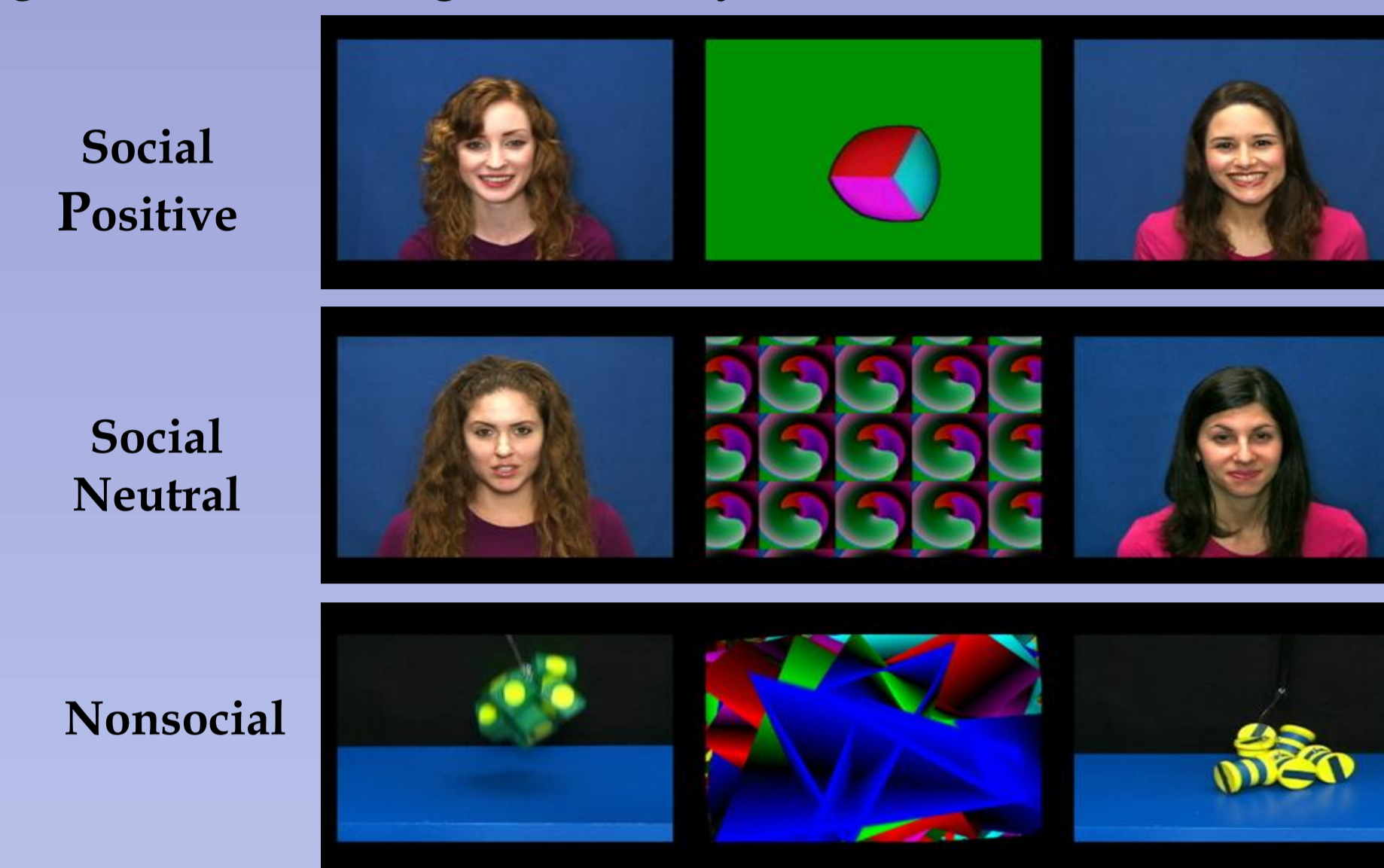
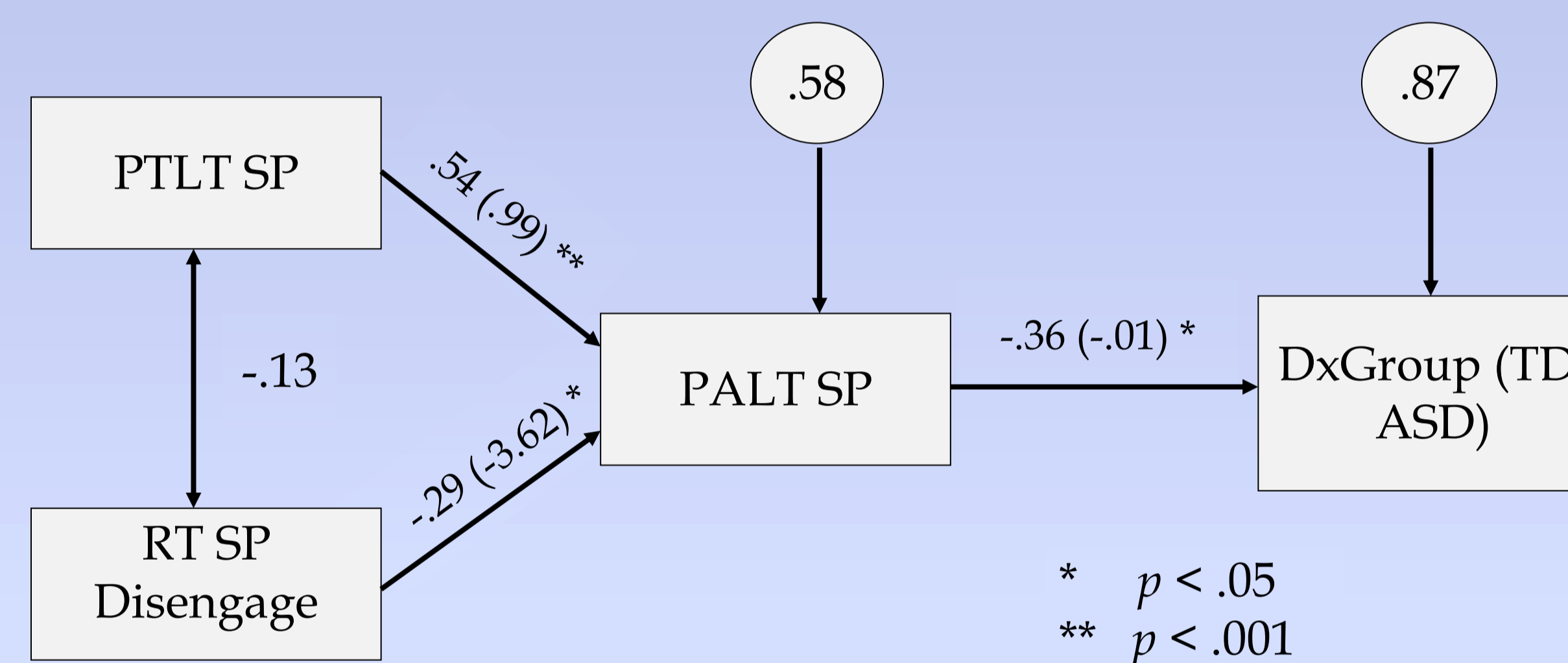


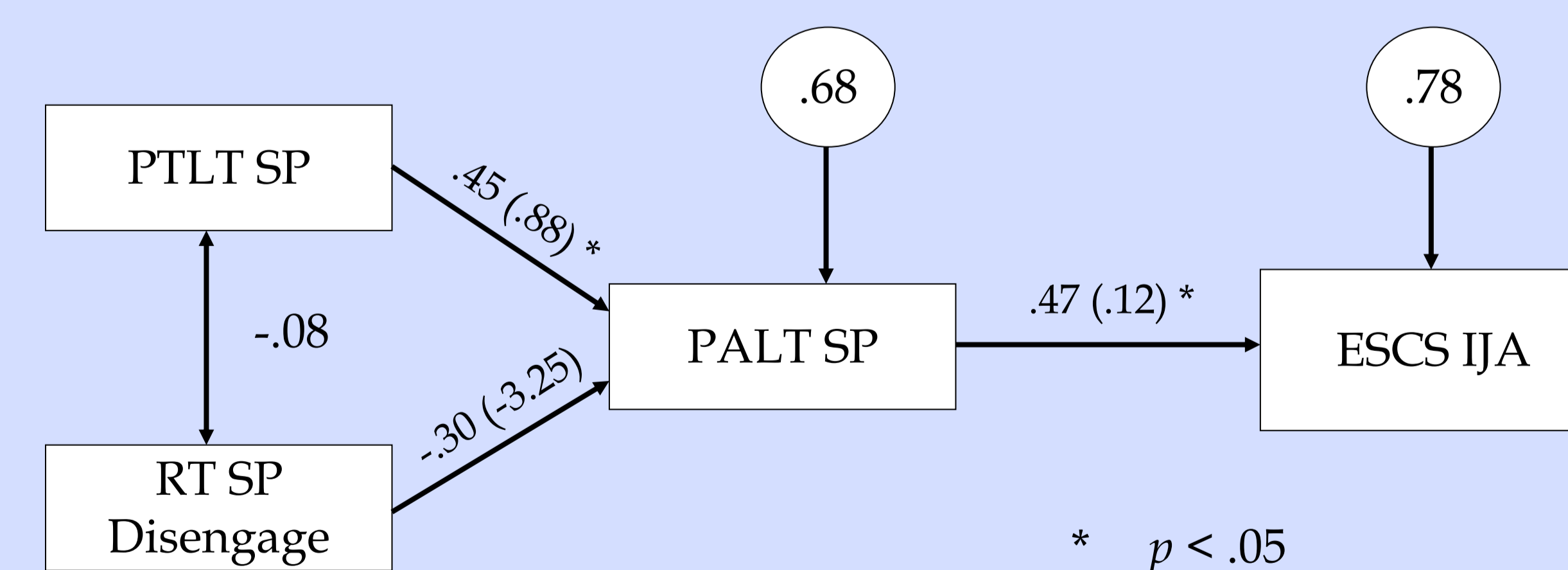
Figure 2. Diagnostic Status Model ($N = 32$)



Note. For path coefficients, standardized coefficients are presented first and unstandardized coefficients are in parentheses.

Interpretation of Significant Unstandardized Path coefficients:
PTLT -> PALT: A 1% increase in intersensory matching (PTLT) predicted a .99% increase in attention maintenance (PALT; $p < .001$).
RT Disengage -> PALT: A one second decrease in RT Disengage predicted a 3.62% increase in attention maintenance (PALT; $p = .03$).
PALT -> Diagnostic Status: A 1% increase in attention maintenance (PALT) predicted a .01% decrease in the probability of having a diagnosis of ASD ($p = .03$).

Figure 3. IJA/Social Functioning Model ($N = 16$).



Note. For path coefficients, standardized coefficients are presented first and unstandardized coefficients are in parentheses.

Interpretation of Significant Unstandardized Path coefficients:
PTLT -> PALT: A 1% increase in intersensory matching (PTLT) predicted a .88% increase in attention maintenance (PALT; $p = .03$).
PALT -> IJA: A 1% increase in attention maintenance predicted a .12% increase the number of IJA instances in children with ASD ($p = .03$).

Results contd.

Results were consistent with our predictions. Children who show enhanced intersensory matching and shorter latencies to disengage attention also show longer attention maintenance to social events, and are less likely to receive a diagnosis of ASD. Evaluation of the same model for nonsocial events revealed several instances of ill fit, indicating that longer attention to nonsocial events did not predict diagnostic outcome.

IJA/Social Functioning Prediction (Figure 2; $N=16$): It was expected that higher PTLTs and lower RTs to disengage would predict greater PALTs to social events, and greater PALTs to social events would predict more IJAs in children with ASD ($N = 16$). No significant points of ill fit emerged, $\chi^2(2) = .02$, $p = .99$. The variables in the model accounted for 22% of the variance in IJA performance and 32% of the variance in attention maintenance. Results for intersensory processing and attention maintenance were consistent with our predictions. Children with ASD who show enhanced intersensory matching are more likely to show longer attention maintenance to social events, and in turn, more instances of IJA. Evaluation of indices of model fit for nonsocial events revealed several instances of ill fit, indicating that longer attention to nonsocial events did not predict IJA performance.

Conclusions

These preliminary analyses (complete sample size to be $N = 24$ per diagnostic group) reveal new relations among three fundamental indices of attention and their ability to predict diagnostic status and IJA performance in ASD. This is the first study to provide a model linking disengagements and intersensory processing of social events with diagnostic outcome. Further, this relationship was found to be mediated by the level of attention to social events (speaking faces) but not nonsocial events. Findings indicate that enhanced intersensory processing and lower latencies to disengage from a competing stimulus independently contribute to longer attention maintenance to social speech events (social orienting). Further, enhanced social orienting leads to a decreased probability of having a diagnosis of ASD. For children with ASD, enhanced intersensory processing leads to enhanced social orienting (longer attention maintenance to speech events), and to increased social communicative functioning (IJA). These findings demonstrate the feasibility of assessing fundamental aspects of attention to naturalistic audiovisual events in a single protocol and using the child's performance to predict diagnostic status and social communicative functioning in ASD. They provide critical information for guiding targeted interventions for children with ASD and infants at risk for a diagnosis of ASD.

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