

Impaired Detection of Temporal Synchrony for Social and Nonsocial Events in Children with Autism Spectrum Disorders

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Background

Intersensory processing develops across the first year of life and is a fundamental building block for typical social and communicative functioning (Bahrack, 2010; Bahrack & Lickliter, 2002). However, children with autism spectrum disorders (ASD) appear to show altered intersensory processing with impaired temporal synchrony perception (Bebko et al., 2006), impaired use of visual speech in noise (Smith & Bennetto, 2007), and a wider temporal window for audiovisual integration (Foss-Feig et al., 2010). Furthermore, they show social attention deficits, including impaired disengagement and decreased attention to social as compared with nonsocial events (Bahrack et al., 2009; Newell et al., 2007). Given that social events provide an extraordinary amount of intersensory redundancy (synchrony, rhythm, tempo, and intensity changes invariant across face, voice, and gesture; Bahrack, 2010), and TD infants are attracted to intersensory redundancy (Bahrack & Lickliter, 2002), a general intersensory processing disturbance could lead to impairments in social orienting in ASD.

Objectives

The objective of the current research was to assess intersensory processing of audiovisual temporal synchrony for social and nonsocial events in young children with ASD, typical development (TD), and developmental delays (DD) using the intersensory processing measure from our Behavioral Attention Assessment Protocol (BAAP; Newell et al., 2007). We predicted that compared with TD and DD children, children with ASD would show intersensory processing impairments (e.g., no significant preference for synchronous over asynchronous audiovisual events), particularly for social events, which are more complex and provide enhanced intersensory redundancy (Bahrack, 2010).

Method

Thus far, data from 33 2- to 5-year-old children have been collected. The sample included children with ASD ($N = 12$; 3.93 yrs), DD ($N = 8$, 4.15 yrs), and TD ($N = 13$, 2.71 yrs) with Mullen composite mental ages of: ASD = 2.63 yrs; TD = 3.25 yrs; DD = 3.63 yrs ($F(2, 20) = 1.43$, $p = .26$). Children were presented with trials consisting of a central stimulus (3 s) followed by two side-by-side peripheral events (10 s). One peripheral event was synchronous with the soundtrack and the other was presented out of synchrony (i.e., asynchronously). Three event types were presented in blocks of 20 trials each, depicting social neutral events (woman speaking with neutral affect), social positive events (woman using infant directed speech with positive affect, exaggerating intersensory redundancy), and nonsocial events (objects impacting a surface in an erratic temporal pattern; see Figure. 1). The proportion of total looking time (PTLT) spent fixating the sound synchronous event was calculated for each event type. TD infants have shown audiovisual synchrony matching for each of these event types in the first 6 months of life. Audiovisual synchrony also makes a variety of nested redundant properties apparent, including tempo, rhythm, duration, and intensity between sounds and sights (Bahrack & Lickliter, 2002).

Figure 1: Images of the dynamic stimulus events.

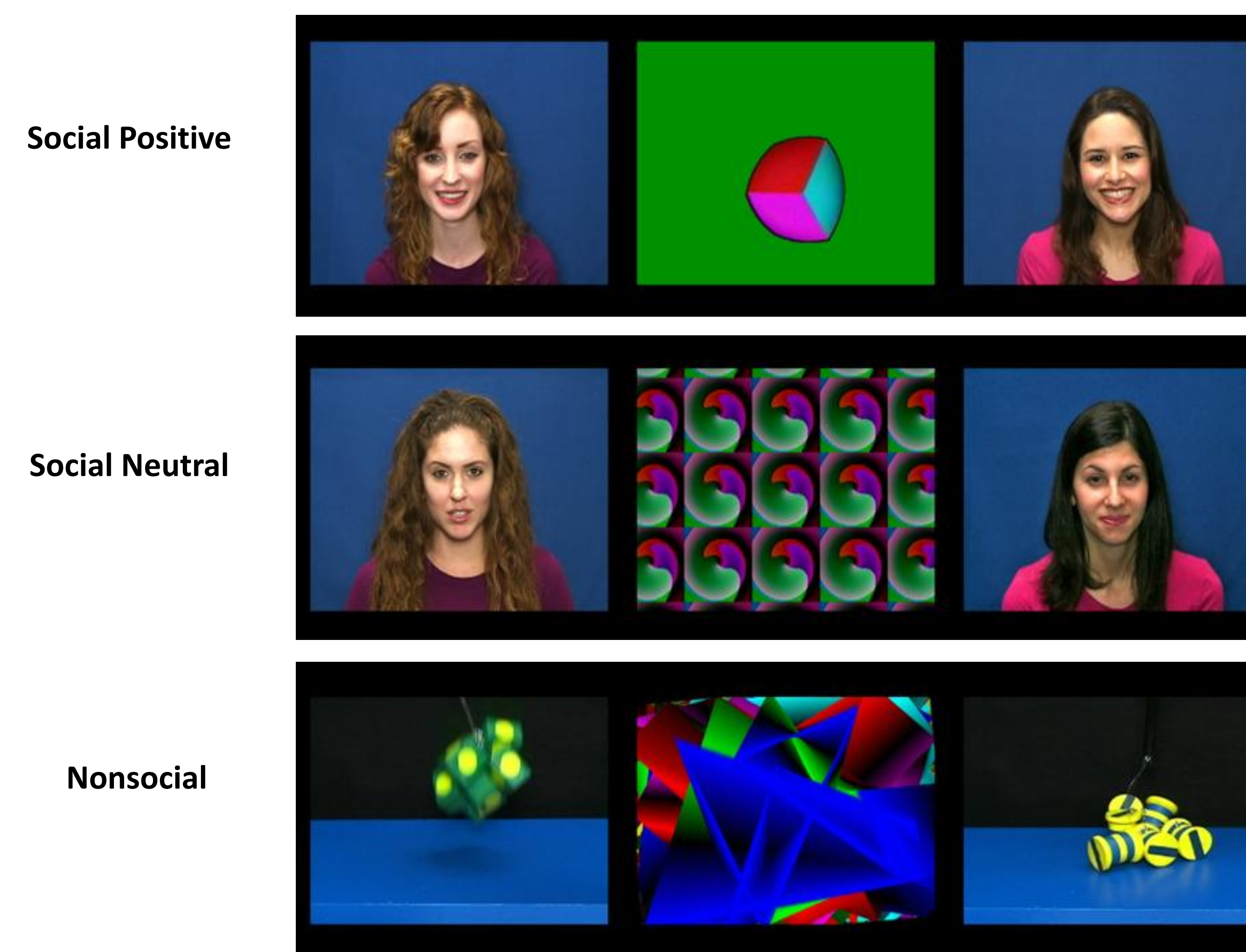
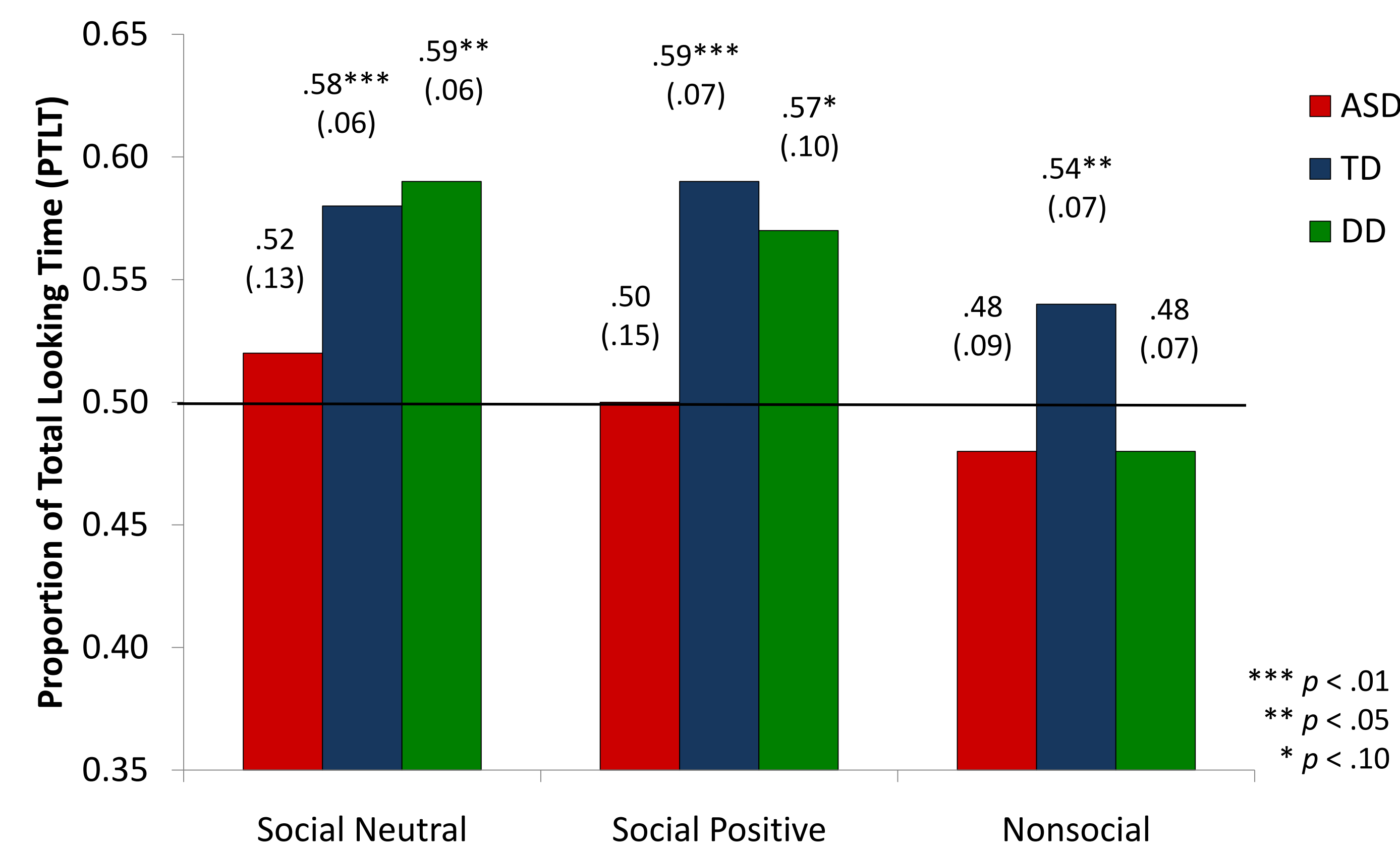


Figure 2: Proportion of total looking time (PTLT) to the sound synchronous event for children with autism (ASD), typical development (TD), and other developmental delays (DD) as a function of event type (social neutral, social positive, nonsocial).



Results

A diagnostic group (ASD, TD, DD) x event type (social neutral, social positive, nonsocial) ANOVA revealed a main effect of diagnostic group, $F(2, 30) = 3.70$, $p < .04$, with TD children showing greater PTLTs than children with ASD ($p = .01$). A main effect of event type also emerged, $F(2, 60) = 5.19$, $p = .01$, with greater PTLTs to social than nonsocial events ($ps < .03$). In addition, TD children showed significant matching of films and soundtracks (PTLTs greater than chance, .50) for all three types of events ($ps < .05$), whereas DD children showed significant matching for social neutral events ($p = .01$) and trending matching for social positive events ($p = .07$). In contrast, children with ASD showed no evidence of audiovisual matching for any event types ($ps > .60$; see Figure 2).

Conclusions

Consistent with our predictions, these findings indicate that children with ASD show impaired intersensory processing skills. They showed no evidence of detecting face-voice synchrony in social events or object-sound synchrony in nonsocial events. In contrast, typically developing children detected audiovisual synchrony for both social and nonsocial events, and children with other developmental delays thus far have shown detection of face-voice synchrony for social events with neutral affect. Further, across all participants, there was greater intersensory matching for social events, which, compared with nonsocial events, provide enhanced amounts of intersensory redundancy. These findings are consistent with prior findings of impaired audiovisual temporal synchrony detection in children with ASD (e.g., Bebko et al., 2006; Foss-Feig et al., 2010) and are compatible with a general intersensory processing disturbance underlying the development of social orienting impairments in ASD.

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