The Development of Intersensory Processing of Social and Nonsocial Events from Infancy Through Childhood

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Introduction

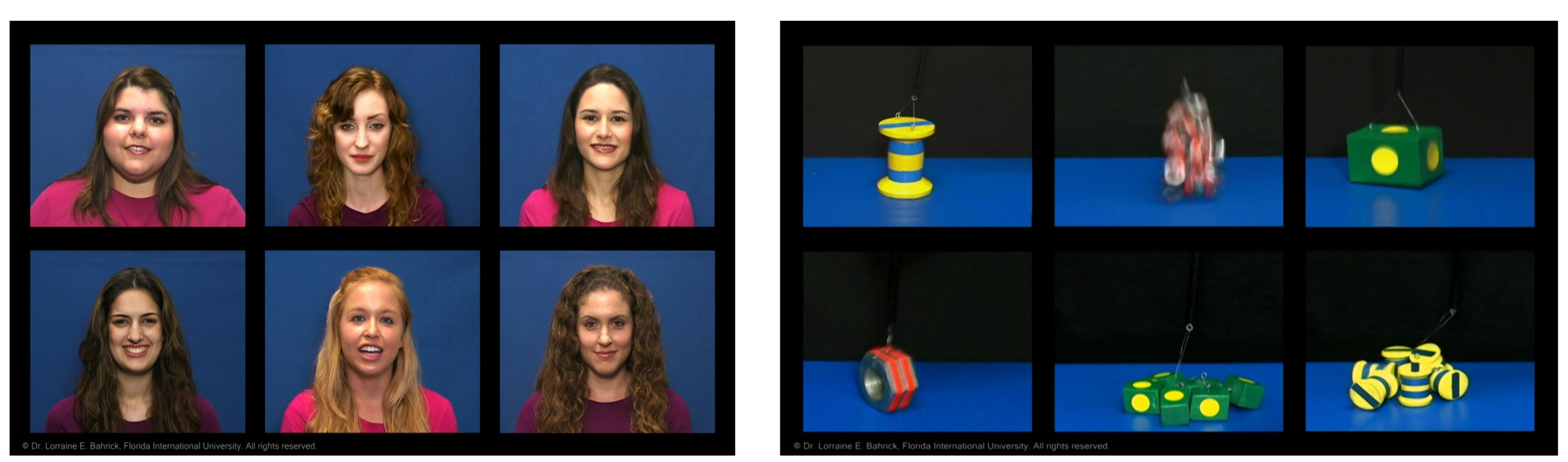
Intersensory processing is a fundamental skill that promotes perceptual, cognitive, and social development across species (Bahrick & Lickliter, 2002, 2012). Intersensory redundancy (temporal synchrony across the senses) guides selective attention and promotes detection and processing of amodal properties (e.g., tempo, rhythm, intensity), particularly in early development when attentional resources are limited. Developmental differences in intersensory processing have been found across age (for a review, see Bremner, Lewkowicz, & Spence, 2012). However, there is currently no single method for assessing intersensory processing skills across the lifespan and no individual difference measures for infants or young children. Further, most assessments of intersensory skills in children and adults rely on verbal responses, and thus cannot be used with nonverbal infants and children.

To address these needs, we have developed the Intersensory Processing Efficiency Protocol (IPEP), a fine-grained, nonverbal individual difference measure that can index speed and accuracy of intersensory processing (Bahrick et al., 2013). The IPEP assesses selective looking to one acoustically synchronized visual event (target) in the context of multiple competing visual events (distractors), similar to real-world "noisy" environments. The purpose of the present study was to assess the developmental trajectory of speed and accuracy of intersensory processing using the same test, from infancy through childhood. We predicted that increased speed and accuracy to detect the synchronized audiovisual target and decreased variability, reflecting greater stability in intersensory processing, would be evident across age.

Methods

Forty-one children between 5 months and 11 years of age (M = 3.73 yrs, SD = 3.17; range: .45 to 10.62 years) received trials consisting of six dynamic, concurrent social (six women reciting different stories in infant-directed speech) and nonsocial (six objects striking a surface in varying erratic temporal patterns) events arranged in a 3x2 matrix (see Figure 1). Each 6 s trial consisted of a natural soundtrack synchronized with the movements of one event (target) and asynchronous with the other five events (distractors). Alternating blocks of social and nonsocial events were presented (12 trials per block; 48 trials total). Events were presented on a wide-screen monitor and an external Tobii (x120) eye-tracker captured children's visual fixations.

Figure 1. Static images of dynamic social and nonsocial events.



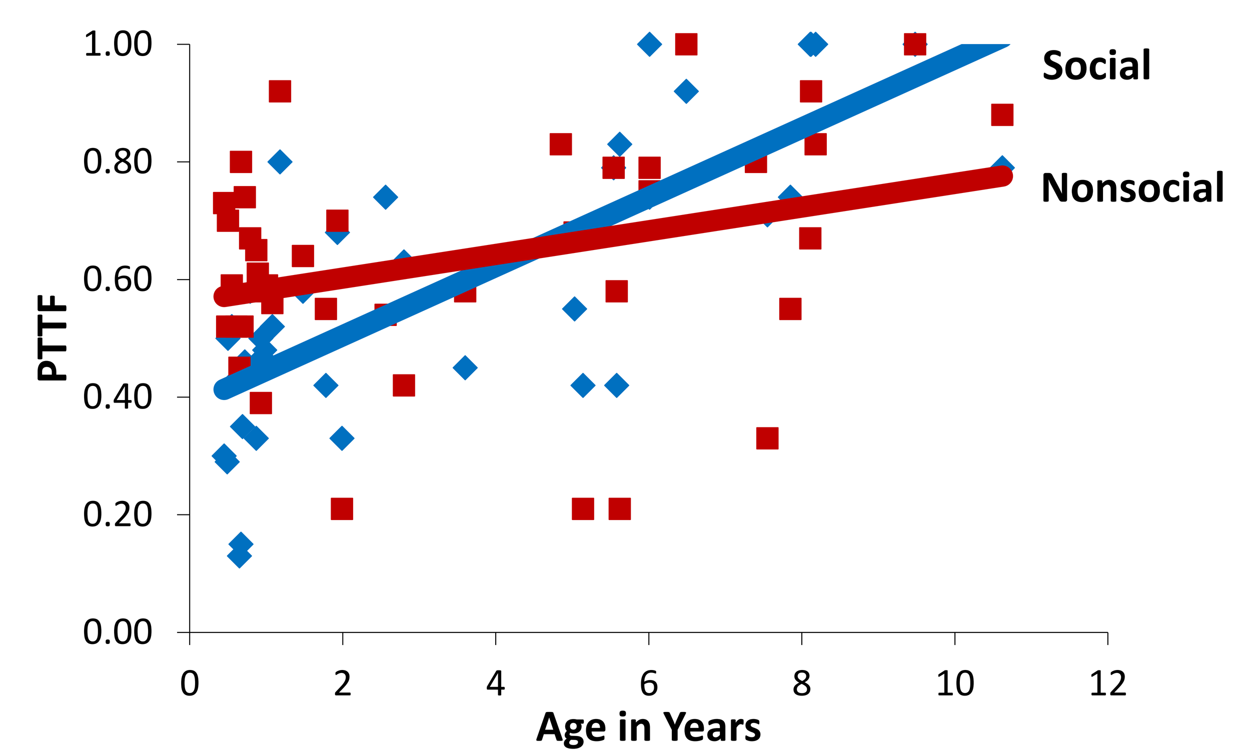


Figure 2. Scatterplot and slopes for the proportion of trials on which the target was fixated (PTTF) across age in years for social and nonsocial events.

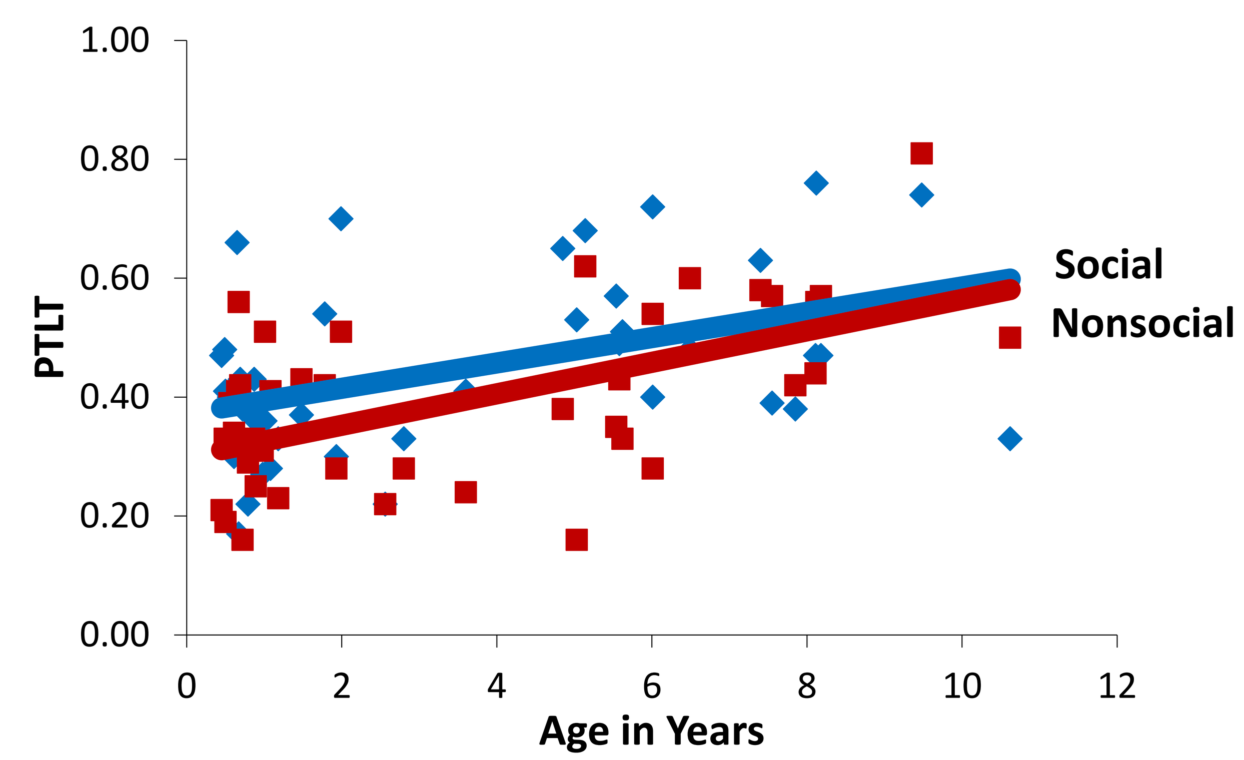


Figure 3. Scatterplot and slopes for the proportion of total looking time (PTLT) across age in years for social and nonsocial events.

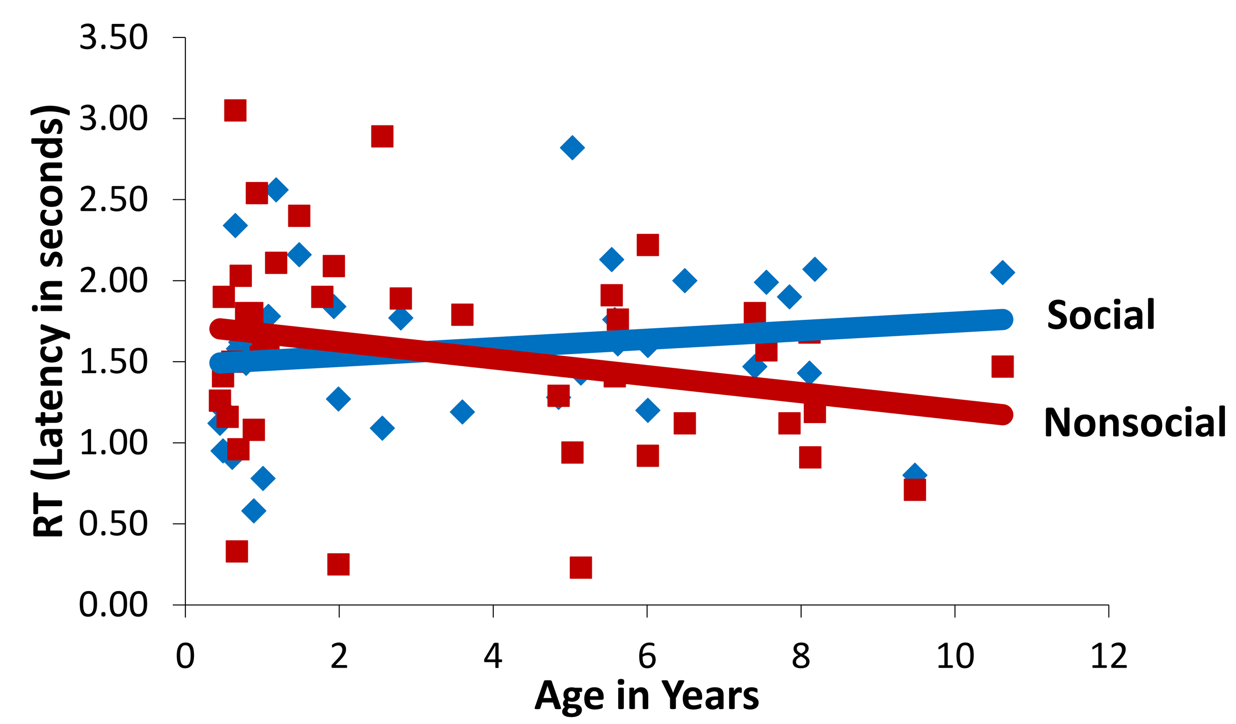


Figure 4. Scatterplot and slopes for the latency in seconds to fixate the target (RT) across age in years for social and nonsocial events.

Table 1. Unstandardized regression coefficients (b), standard error (SE), and standardized coefficients (b*) for the proportion of trials on which the target was fixated (PTTF), the proportion of total looking time (PTLT), and reaction time (RT) regressed across age in years for social and nonsocial events.

	Social			Nonsocial		
	b	*SE*	*b**	*b*	*SE*	*b**
PTTF	.06***	.01	.76	.02*	.01	.32
PTLT	.02*	.01	.43	.03***	.01	.56
RT	.04	.03	.22	-.05	.03	-.26

Note: * $p < .05$, ** $p < .01$, *** $p < .001$

Results

Accuracy of target detection was indexed by the proportion of total trials on which the target was fixated (PTTF) and by the proportion of total looking time (PTLT) to the target event. Speed was indexed by the latency in seconds (reaction time; RT) to fixate the target. To assess whether speed and accuracy increased across age, three analyses were conducted regressing PTTF, PTLT, and RT scores on to age in years. Results for accuracy of target detection indicated significant linear increases in PTTF and PTLT scores from infancy through childhood for social and nonsocial events (see Table 1; Figures 2 and 3), with no change in variability (ps > .48). Across age, children were increasingly successful at finding the target and fixated it longer. In contrast, RT to find the target showed no change across age (see Table 1; Figure 4). Thus, surprisingly, there was no evidence that children were faster to fixate the synchronized target than were infants. However, consistent with predictions, there was a significant decrease across age in variability of RT to find the target for social, but not nonsocial, events (p =.04; one-tailed), indicating that with increasing age, speed of detecting social targets becomes more stable.

Conclusions

These findings demonstrate that the accuracy of intersensory processing improves from infancy through childhood. Between 5 months and 11 years of age, children were increasingly likely to detect the acoustically synchronized targets, as well as to fixate them longer than the asynchronous visual distractors. These findings suggest that with development, children become more accurate in detecting and attending to synchronous audiovisual events amidst competing stimulation. In contrast, although the speed of fixating the target showed no evidence of change across age, the variability in speed of detecting social targets decreased across age, suggesting greater stability in speed of intersensory processing of social events with age. Future research assessing developmental change across the first two years will explore these issues more closely. Together, the present findings demonstrate the IPEP provides a fine-grained individual difference measure of intersensory processing that can be used across a wide age range, from nonverbal infants and toddlers, to older children. Further, it has the potential for identifying atypical developmental trajectories in intersensory processing.

References

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