Individual Differences in Intersensory Processing Predict Pre-Literacy Skills in Young Children

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Introduction

Intersensory processing (coordinating stimulation across multiple sensory modalities) provides a foundation for language development (Bahrick & Lickliter, 2012, 2014). For example, parents teach their infants novel words by temporally synchronizing object movements with verbal labels, highlighting object-label relations (Gogate et al., 2000). Further, 7-month-old infants detect arbitrary object-vowel pairings when the object is moved in synchrony with the vowel sounds, but not when it is moved asynchronously or is static (Gogate & Bahrick, 1998). Early language competencies, in turn, promote the development of pre-literacy skills, such as phonemic awareness (discriminating syllables within words) and phonics (matching letters and sounds), which predict reading outcomes (Whitehurst & Lonigan, 1998). In the current study, we investigated the relationship between children's emergent literacy skills (phonemic awareness, phonics) and their intersensory processing abilities using our new individual difference measure, the Intersensory Processing Efficiency Protocol (IPEP; Bahrick et al., 2013, submitted), and a curriculum-based measure of oral reading fluency.

Methods

Rising kindergarteners and first-graders between 5 and 7 years of age participating in a summer reading program for children at risk for literacy delays (N = 44; age M = 6.24 years, SD = .48) were administered the IPEP and the Letter Names and Letter Sounds probes from the Oral Reading Fluency test (ORF; Fuchs et al., 2001). An additional 20 children were tested, but were excluded because their reading abilities were above grade-level, indicating no literacy delays.

The IPEP is a fine-grained measure of accuracy of audiovisual synchrony detection. Participants must locate a sound-synchronous target event among five distractors (speaking faces or moving objects; Figure 1) across 48 8-s trials (24 face, 24 object). The IPEP was administered on a touch-screen tablet and participants were instructed to touch the face/object that matched the sound. Intersensory accuracy (the proportion of trials on which participants touched the target) was calculated.

In the ORF, children must identify from a list of printed letters, as many letter names (ORF Letter Names; 77 items) and as many letter sounds (ORF Letter Sounds; 54 items) as possible in one minute per test. The percentage of correctly identified letter names and sounds is calculated.

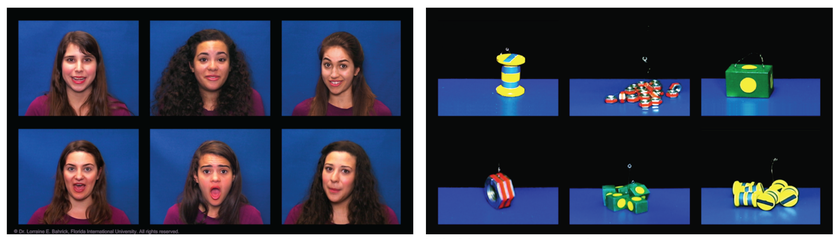

Figure 1. Static image depicting the dynamic social (left) and nonsocial (right) events shown to the children in the IPEP.

Results: Intersensory Accuracy & Pre-Literacy Skills

On the IPEP, children found the target event on 63.3% of the trials on average (SD = 21%). This percentage is significantly greater than that expected by chance (16.67% chance; $t(43)$ = 14.52, p < .001). For the ORF, children provided the correct response for M = 70.2% of letter names (SD = 26.8) and M = 40.1% of letter sounds (SD = 19.9). Intersensory accuracy on the IPEP was significantly correlated with ORF Letter Names and ORF Letter Sounds scores (rs = .50 and .45 respectively, ps < .003; Figure 2).

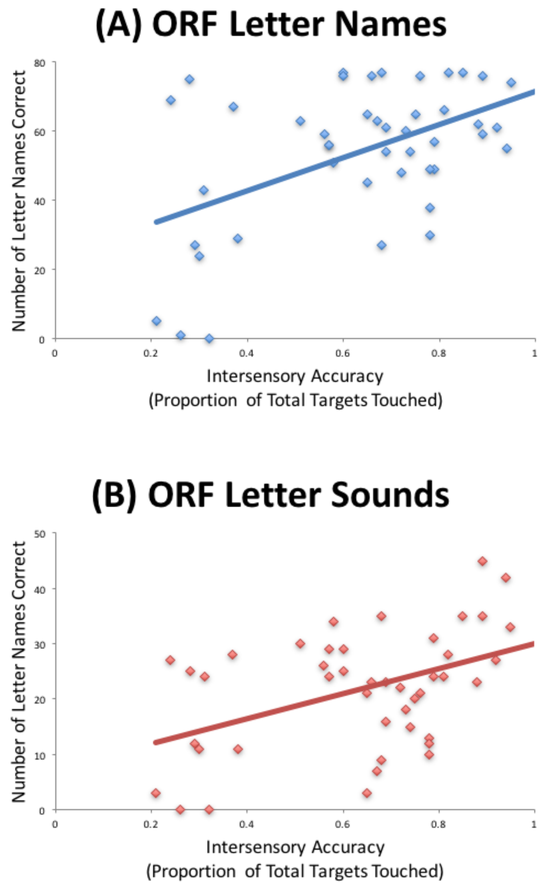

Figure 2. Scatterplots depicting relations between IPEP intersensory accuracy (proportion of total targets found) and (A) ORF Letter Names (top) and (B) ORF Letter Sounds (bottom). Lines represent linear regressions.

Results: Intersensory Accuracy, Pre-Literacy Skills, & Chronological Age

ORF Letter Names and ORF Letter Sounds scores were also correlated with chronological age (rs = .53 and .46 respectively, ps < .003). However, partial correlations revealed that IPEP performance was still significantly related to ORF Letter Names (r = .44, p = .003) and ORF Letter Sounds (r = .39, p = .01) even after controlling for chronological age (see Figure 3). Moreover, IPEP performance accounted for an additional 14.1% of the variance in ORF Letter Names (total R^2 = .43) and 11.9% of the variance in ORF Letter Sounds (total R^2 = .33) above and beyond the effects of chronological age, both significant proportions (ps = .003 and .01 for Letter Names and Letter Sounds respectively).

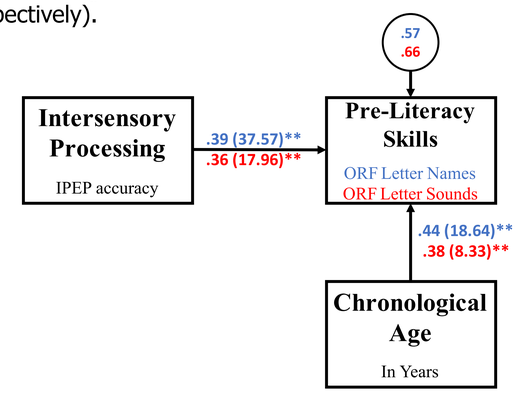

Figure 3. Structural model depicting relations between IPEP intersensory accuracy (proportion of total targets found), ORF Letter Names (in blue) and ORF Letter Sounds (in red), and chronological age (years). Standardized regression coefficients are presented outside the parentheses and unstandardized coefficients are presented inside parentheses. Error variance (proportions of variance unaccounted for) is presented in the circle. *Note:* **p < .01

Conclusions

Children with greater accuracy in selecting a sound-synchronous target showed greater knowledge of letter names and sounds, even after controlling for chronological age. These exciting, preliminary findings are among the first to demonstrate relations between intersensory processing skills (audiovisual synchrony detection) and pre-literacy skills. Results are consistent with a hypothesized developmental cascade in which intersensory processing skills (audiovisual synchrony detection) provide a foundation for word mapping, which in turn provides a foundation for pre-literacy skills (letter name- and sound mapping) and in turn, reading skills.

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