Selective Looking by Young Children: A New Test of Sensitivity to Intersensory Redundancy During Competing Visual Stimulation

Lorraine E. Bahrick, Irina Castellanos, Elizabeth Frame, James Torrence Todd,
Mileini Campez, & Sheila Krogh-Jespersen

FLORIDA INTERNATIONAL UNIVERSITY

Background

Adults show impressive selective attention skills including selective listening – detecting a single speech stream amidst competing conversations (Cherry, 1953), and selective looking - attending to one visual event while ignoring another concurrent event (Neisser & Becklen, 1976). These skills develop in infancy and are guided by selective attention to intersensory redundancy (e.g., temporal synchrony, rhythm, and tempo). For example, when presented with two superimposed visual events (i.e., hands clapping and a slinky toy moving), 4-month-old infants selectively attended to the film that was synchronous with its natural soundtrack and ignored the asynchronous film (Bahrick, Walker, & Neisser, 1981). Temporal synchrony is considered the glue that binds stimulation across the senses and provides a foundation for perceptual, cognitive, language, and social development (Bahrick, 2010; Bahrick & Lickliter, 2002, 2012).

In this study, we introduce a new method, the Intersensory Processing Efficiency Protocol (IPEP), to assess 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 IPEP is the first fine-grained, nonverbal measure of intersensory processing that indexes both accuracy and speed of detecting a target event (both social and nonsocial).

Methods

Sixty-four children (*M* = 45.5 months; *SD* = 3.2) were randomly assigned to either the social (six women reciting different stories in infant-directed speech) or nonsocial (six objects striking a surface in varying erratic temporal patterns) event condition (*N* = 32 each). Children viewed six dynamic, concurrent visual events (one target and five distractors) arranged in a 3 x 2 matrix (see Figure 1), across two blocks (synchronous audiovisual and unimodal visual, order counterbalanced), with each block consisting of twelve 6 s trials. In the synchronous audiovisual (experimental) block, each trial consisted of a 6 s natural soundtrack synchronized with the movements of one of the six events (target) and asynchronous with the other five events (distractors). The unimodal visual (control) block was identical to the audiovisual block, except no soundtracks were played.

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

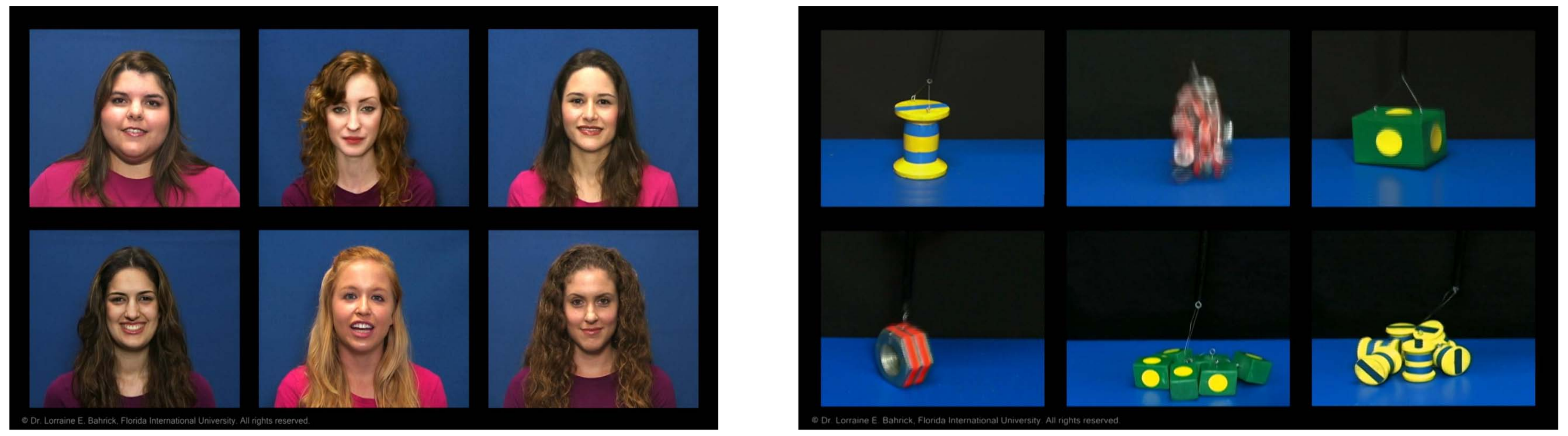


Figure 2. Proportion of total trials on which the target was fixated (PTTF) as a function of event type (social, nonsocial) and stimulation (synchronous audiovisual, silent visual).

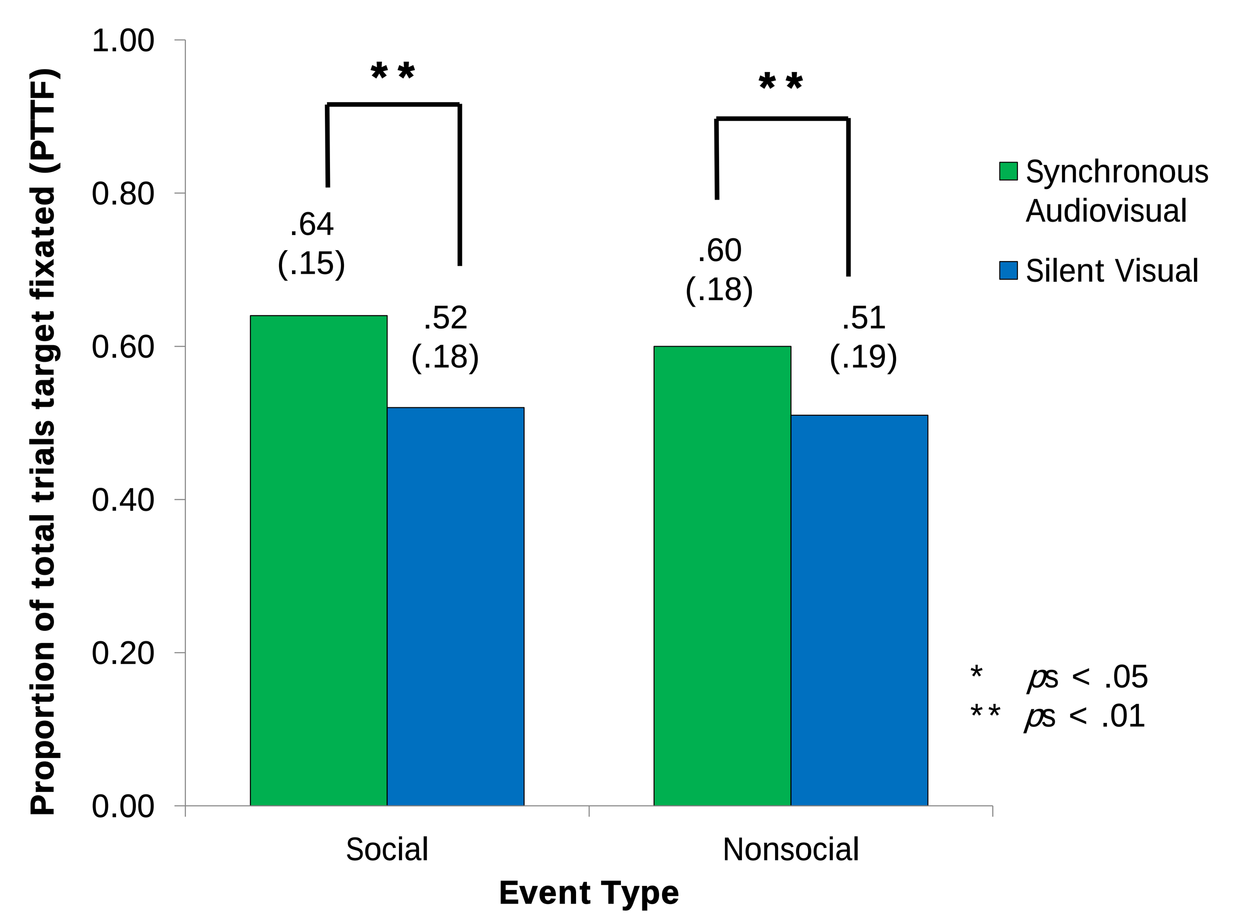
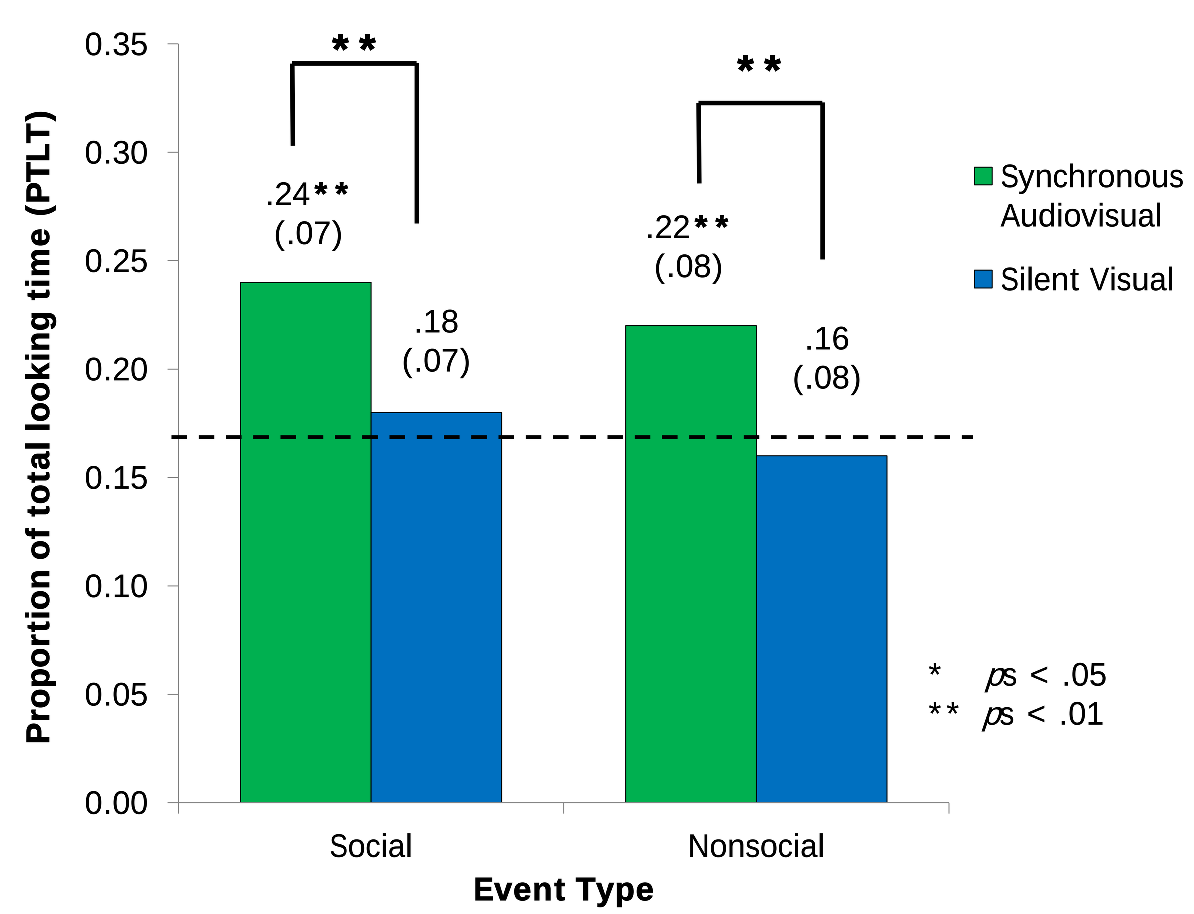


Figure 3. Proportion of total looking time (PTLT) to the target event as a function of event type (social, nonsocial) and stimulation (synchronous audiovisual, silent visual).



Results

Events were presented on a wide-screen monitor and an external Tobii (x120) eye-tracker captured children's visual fixations. Accuracy of target detection was indexed by the proportion of total trials on which the target was fixated (PTTF; Figure 2) and by the proportion of total looking time (PTLT) to the target event (Figure 3) in the synchronous audiovisual condition. For the unimodal visual condition, PTTFs and PTLTs were calculated by designating as "target", the same event/location as for the corresponding trial in the synchronous audiovisual condition. Children displayed significantly greater PTTFs during synchronous audiovisual as compared to unimodal visual exposure for both social, $t(30) = 3.49$, $p = .001$, and nonsocial events, $t(30) = 2.63$, $p = .01$. Similarly, PTLTs to the target events during synchronous audiovisual stimulation were significantly greater than PTLTs during unimodal visual exposure for both social, $t(30) = 3.65$, $p = .001$, and nonsocial events, $t(30) = 2.81$, $p = .01$. Further, for both events, PTLTs were significantly greater than chance (.17) during synchronous audiovisual social, $t(31) = 5.96$, $p < .001$, and nonsocial, $t(31) = 3.29$, $p = .003$, exposure, but not during unimodal visual exposure ($ps > .34$). Mean reaction time to fixate the target was 2.38 s ($SD = .73$) for audiovisual social and 1.97 s ($SD = 1.01$) for audiovisual nonsocial events (with no reaction time difference between audiovisual and unimodal visual events).

Children did not fixate all six events/locations on every trial. To assess evidence of target detection in the audiovisual conditions alone and at the same time control for the spatial location of each woman/object, a PTLT difference score was calculated for each of the six events/locations by taking the mean total looking time to an event/location when it was the target (synchronous) and subtracting the mean total looking time to that event/location when it was a distractor (asynchronous). The mean PTLT difference score across all six events/locations was significantly greater than chance (zero) for both audiovisual social ($M = .09$, $SD = .08$, $t(31) = 6.54$, $p < .001$) and nonsocial presentations ($M = .05$, $SD = .09$, $t(31) = 3.47$, $p = .002$).

Conclusions

These findings indicate that audiovisual temporal synchrony successfully guides children's selective attention to a target event even in the context of competing stimulation from five concurrent visual events in both social and nonsocial contexts. This new method provides a fine-grained, sensitive index of intersensory functioning that can be used with nonverbal children. It has important applications including indexing individual differences in selective attention to audiovisual synchrony across development for children of both typical and atypical development. These skills are critical given that selective attention provides the gateway to all that is perceived, learned, and remembered.

References

Bahrick, L. E. (2010). Intermodal perception and selective attention to intersensory redundancy: Implications for typical social development and autism. In J. G. Bremner & T. D. Wachs (Eds.), *The Wiley-Blackwell Handbook of Infant Development: Vol. 1. Basic Research* (2nd ed., pp. 120–165). Malden, MA: Wiley-Blackwell. doi:10.1002/9781444327564.ch4

Bahrick, L. E., & Lickliter, R. (2012). The role of intersensory redundancy in early perceptual, cognitive, and social development. In A. Bremner, D. J. Lewkowicz, & C. Spence (Eds.), *Multisensory development* (pp. 183-206). New York: Oxford University Press.

Bahrick, L. E., Walker, A. S., & Neisser, U. (1981). Selective looking by infants. *Cognitive Psychology*, *13*, 377–390.

Cherry, E. C. (1953). Some experiments on the recognition of speech, with one and two ears. *Journal of the Acoustical Society of America*, *25*, 975–979.

Neisser, U., & Becklen, R. (1975). Selective looking: Attending to visually specified events. *Cognitive Psychology, 7(4),* 480-494.

Presented at the meeting of the Society for Research in Child Development, Seattle, WA. This research was supported by NICHD RO1 HD053776 and K02 HD064943 grants awarded to the first author.