# Attention to Multimodal Events from 3 to 12 Months: Developmental Differences are Magnified by Competing Stimulation

James Torrence Todd, Kasey C. Soska, & Lorraine E. Bahrick

## Introduction

Children develop in an environment that provides a flux of auditory, visual, and tactile stimulation from concurrent events. Attention becomes more flexible and efficient across early development, with improvements in disengaging from competing stimulation and maintaining attention to meaningful objects and events (Colombo, 2001; Ruff & Rothbart, 1996). However, assessments of attention have typically involved presenting static images or silent animations with low ecological validity, limiting generalizability to the natural environment of overlapping multimodal events. The Multisensory Attention Assessment Protocol (MAAP; Bahrick, Todd, & Soska, in prep; Todd, Soska, Costales, & Bahrick, 2015) was designed to assess fine-grained individual and developmental differences in attention under conditions that more closely simulate the richness of the multimodal environment. Previous findings using the MAAP demonstrated a marked cost of competing stimulation on attention maintenance and speed of shifting, which decreased across age between 3 and 6 months (Todd et al., 2015). In the present study, we extend our longitudinal investigation to infants of 12 months of age.

## Methods

Forty-one infants (data collection ongoing) received the MAAP at 3, 6, and 12 months of age. Each trial began with a 3 s central visual event (animated shapes), immediately followed by two side-by-side lateral events (12 s), one in synchrony with its natural soundtrack (Figure 1). Lateral events were social (two women speaking) or nonsocial (two objects striking a surface). The central event remained on throughout the lateral events on 12 trials (competition trials), and was turned off on 12 trials (no competition trials). We calculated measures of *maintenance* (proportion of available time looking to lateral events; PALT), *disengagement* (reaction time, RT, to look away from central to lateral events on competition trials; RT Disengage), *orienting* (RT to look away from central to lateral events on no competition trials; RT Orient), and *failure to disengage* (proportion of trials with no disengagement from the central to the lateral events; PTND).

**Figure 1.** Static images of the social and nonsocial events.

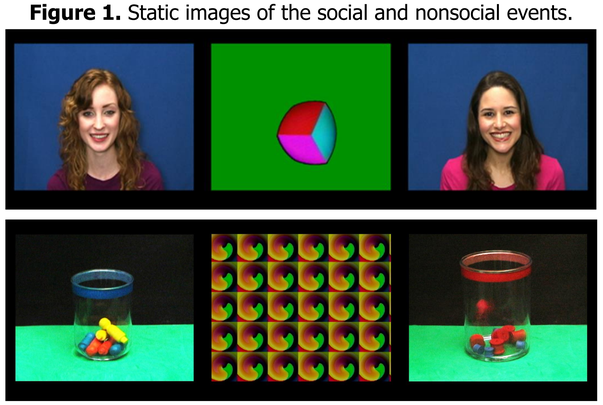


**Figure 2.** Means for maintenance (proportion of available looking time, PALT) as a function of age (3, 6, and 12 months), event type (social, nonsocial), and trial type (competition, no competition). Error bars depict standard error of the mean.

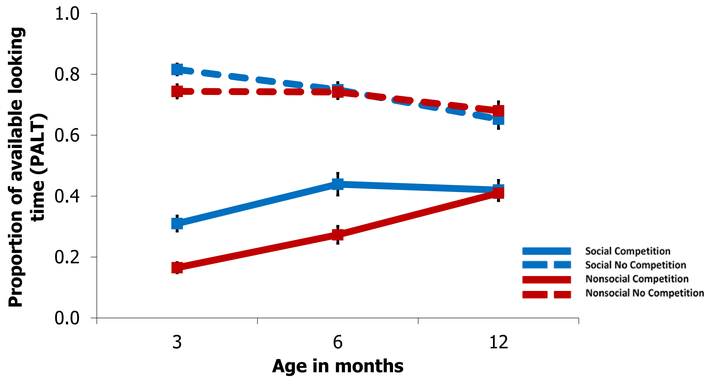



**Figure 3.** Speed of attentional shifting (reaction time, RT) as a function of age (3, 6, and 12 months), event type (social, nonsocial), and trial type (competition, no competition). Error bars depict standard error of the mean.

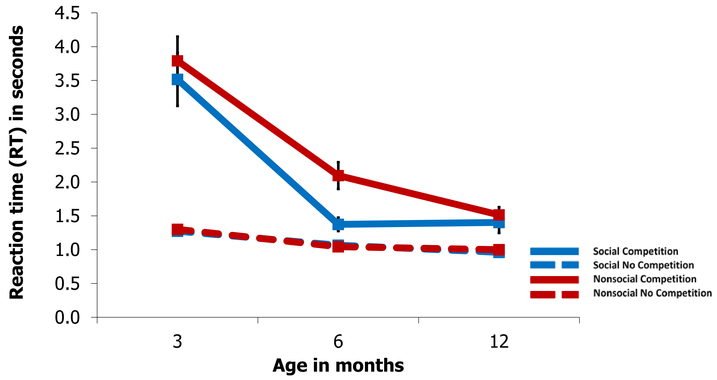
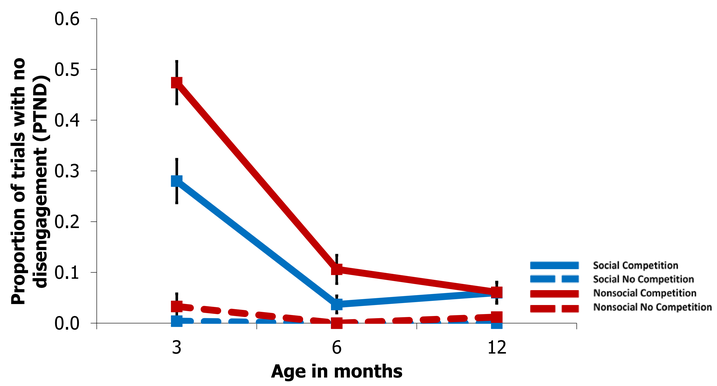



**Figure 4.** Failures to disengage (proportion of trials with no disengagement, PTND) as a function of age (3, 6, and 12 months), event type (social, nonsocial), and trial type (competition, no competition). Error bars depict standard error of the mean.




## Results

*Competition vs no competition trials*: On competition trials, infants at all ages showed lower attention maintenance (PALT; *p*s < .001; Figure 2), longer latencies to shift (RT; *p*s < .001; Figure 3), and more failures to disengage (PTNDs (*p*s < .001; Figure 4) to look to the lateral events as compared with no competition trials. Thus, at all ages and on all measures, we found a significant cost of competing stimulation (from the silent, dynamic central visual event) on attention to the audiovisual lateral events.

*Change across age*: Change across age was evident for all measures of attention; however, the most dramatic change was between 3 and 6 months on competition trials. On competition trials, infants showed improvement between 3 and 6 months on all measures, including increased attention maintenance (PALT), faster disengagement (RT) and decreased failures to disengage (PTND; *p*s < .001; Figures 2, 3, 4). In contrast, between 6 and 12 months, the increase was evident only for attention maintenance (PALT; *p* = .04). On no competition trials, change across age was less dramatic than on competition trials and only evident for two measures, with decreased maintenance and faster speed of shifting between 3 to 12 months (*p*s < .001). Thus, infants showed the greatest change across age on trials during which competing stimulation was present and this was most evident between 3 and 6 months.

*Social vs. nonsocial events*: Differences in attention to social vs. nonsocial events were also evident, particularly at the youngest ages and on competition trials. On competition trials, infants at 3 months showed longer attention maintenance (PALT) and fewer failures to disengage (PTND) to social than nonsocial events (*p*s < .03). At 6 months, they showed longer attention maintenance (PALT) and faster disengagement (RT) to look to social than nonsocial events (*p*s < .001). In contrast, social-nonsocial differences were no longer evident by 12 months (*p*s > .10).

## Conclusions

Maintenance of attention, speed of shifting, and ability to shift attention away from competing stimulation to audiovisual events improves dramatically across the first year. There is a sharp decrease in the cost of competing stimulation on attention maintenance and shifting between 3 to 6 months. The cost of competing stimulation diminishes across age but is still evident at 12 months for attention maintenance. Attention is also greater to social than nonsocial events at 3 and 6 months of age, but not at 12 months. We argue that differences in attention between individuals, event types, developmental levels, or children of typical vs. atypical development, are best identified using protocols such as the MAAP, which include multimodal events with competing stimulation, similar to noisy, real-world environments.

## References

Bahrick, L. E., Todd, J. T., & Soska, K. C. (2016). The Multisensory Attention Assessment Protocol (MAAP): A new nonverbal individual difference measure predicting language and cognition in young children. Manuscript in preparation.

Colombo, J. (2001). The development of visual attention in infancy. Annual Review of Psychology, 51, 337–367. http://doi.org/10.1146/annurev.psych.52.1.337

Ruff, H. A., & Rothbart, M. K. (1996). Attention in early development: Themes and variations. New York, NY, US: Oxford University Press.

Todd, J. T., Soska, K. C., Costales, A., & Bahrick, L. E. (2015, March). The emergence of social attention: Maintenance, disengagement, and orienting of attention to social and nonsocial events from 3 to 6 months. Poster session presented at the Society for Research in Child Development, Philadelphia, PA.

Presented in May 2016 at the meeting of the International Congress on Infant Studies, New Orleans, LA. This research was supported by NICHD RO1 HD053776 and K02 HD064943 grants awarded to the third author.