



Introduction

- Research using infant eye tracking has seen large growth in the methodology and number of studies published in the last decade. Many of these studies have focused on using this methodology to index infant behaviors such as gaze following, face processing, and memory (Oakes, 2011). However, there is a lack of research examining infants' natural visual exploration patterns when viewing a screen, which is relevant for considering these other task related outcomes.
- Infants and children routinely experience screens in their day-to-day lives, yet we do not know from a developmental perspective how young children are visually exploring or attending to information on devices. This is particularly relevant as children are increasingly exposed to learning opportunities via screen-based technologies.
- The Visual Exploration Task (VET) involves a series of images presented in different regions of the screen to index attention viewing preferences to different kinds of stimuli (Elison et al., 2012; Sasson et al., 2011; Sasson et al., 2008).
 - The VET has been used to quantify differences in visual exploration to social versus nonsocial stimuli among individuals with autism (n=51) and typically developing peers (n=43) age 2-16 years old (Elison et al., 2012).
- The current study utilizes the VET to quantify natural viewing patterns to different regions of the screen.
 - We have adapted the VET (Elison et al., 2012) for infants/toddlers by decreasing the number of images on the screen (from a field of 24 to 8).
 - This preliminary investigation is aimed at informing the development and design of screen-based tools and measures that are intended for young children.

Study Aims

- Do infants demonstrate identifiable gaze patterns when viewing a screen?
 - Do infants demonstrate areas of preference on a screen through increased fixation duration to predetermined areas of interest?
 - Do infants demonstrate areas of preference when viewing a screen through increased fixation counts to predetermined areas of interest?
- Does the type of images the child views (social vs nonsocial) make a difference on the infants' viewing patterns?

Methods

- Participants:** Infants (N=68; 40 female, 28 male) participated in a longitudinal study and attended 5 visits in the child development lab at ages 6, 8, 10, 12 and 18 months of age. The table below indicates the number of participants included at each age point. Participants were removed from the data set if the recording contained 15% or less data. The sample was 89.70% Caucasian, 14.71% African American, and 5.88% Hispanic or Latino ethnicity.

Age in Months	N
6	57
8	59
10	57
12	59
18	46

- Eye tracking procedure:** Infants were seated in a high chair 60 cm from the Tobii TX300 eye tracker. A 5-point infant calibration method was then conducted before the administration of the task.
- Visual Exploration Task-Baby (VET-B):** The VET-B task is designed to obtain a measure of how children divide their attention when presented with social and nonsocial images. The task contains 12 static image sets (each containing a field of 8 pictures) presented under the following conditions: *social* (all faces), *nonsocial* (all toys), *mixed social-nonsocial* (faces and toys). We consider here only *social* and *nonsocial* conditions. Each of the 12 image sets is preceded by a central crosshair to focus attention to the center of the screen. Each image set is displayed for 6 seconds.
- Area of Interest (AOI):** AOIs were created to determine the duration and frequency of fixations directed to each image. Square AOIs were created around each picture of the image sets. All AOIs were the same size and no overlap between AOIs occurred.

Measures

- Total fixation duration:** Total fixation duration is calculated by adding the durations of all fixations that have occurred in a given AOI. This measure indicates the amount of time the infant has focused his/her attention on a given image.
- Fixation count:** Fixation count provides the total number of times the infant fixated on an AOI while it was present on the screen. A fixation is defined as the infant's gaze staying in a 30 pixel radius for at least 100ms.

Results

Table 1. ANOVA for AOI Position and Total Fixation Duration and Fixation Count

Dependent Variable	df	F	Sig
Nonsocial Total Fixation Duration	7	28.530	<.001
Social Total Fixation Duration	7	10.950	<.001
Nonsocial Fixation Count	7	11.556	<.001
Social Fixation Count	7	13.221	<.001

Table 2. Post Hoc Bonferroni Test for Significant AOI Position Comparisons in Nonsocial Image Sets

AOI Position Comparisons	NonSocial Total Fixation Duration		NonSocial Fixation Count	
	Mean Difference	Significance	Mean Difference	Significance
2 > 1	.790	<.001		
2 > 3	.834	<.001		
2 > 4	1.16	<.001	2.19	<.001
2 > 5	.867	<.001		
2 > 6	.828	<.001	1.18	<.001
2 > 7	.584	<.001	.93	.011
2 > 8	.915	<.001	.90	.016
4 < 1	-.367	.001	-1.67	<.001
4 < 3	-.323	.010	-1.49	<.001
4 < 5	-.290	.037	-1.38	<.001
4 < 6	-.328	.007	-1.01	.003
4 < 7	-.573	<.001	-1.27	<.001
4 < 8			-1.29	<.001
7 > 5	.283	.048		
7 > 8	.331	.007		

Table 3. Post Hoc Bonferroni Test for Significant AOI Position Comparisons in Social Image Sets

AOI Position Comparisons	Social Total Fixation Duration		Social Fixation Count	
	Mean Difference	Significance	Mean Difference	Significance
2 > 1	.315	.013	.97	.004
2 > 4	.365	.001	.99	.003
2 > 5	.291	.034		
2 > 6	.413	<.001	1.13	<.001
3 > 6	.315	.013	.83	.031
7 > 1	.420	<.001	1.37	<.001
7 > 4	.469	<.001	1.39	<.001
7 > 5	.395	<.001	1.14	<.001
7 > 6	.518	<.001	1.53	<.001
8 > 1	.405	<.001	1.11	<.001
8 > 4	.454	<.001	1.13	<.001
8 > 5	.381	.001	.88	.017
8 > 6	.503	<.001	1.27	<.001

Figure 1. Nonsocial Array with AOI Positions



Figure 2. Social Array with AOI Positions



Discussion

- Results indicate that identifiable patterns exist when an infant views a screen. There are significant differences in the duration and frequency of infant fixations between images on the screen in both social and nonsocial images.
- Nonsocial image sets: Common patterns among nonsocial image sets were a significantly greater fixation duration and frequency count in AOI 2 (top-middle picture) and AOI 7 (bottom-middle picture). The AOI with significantly low fixation duration and frequency counts was AOI 4 (left-side picture). Overall infants demonstrated preferential looking above and below the central point at which they were oriented when the task began.
- Social image sets: Similar patterns were seen as in the nonsocial image sets with AOI 2 (top-middle picture) and AOI 7 (bottom-middle picture) having significantly higher fixation frequency count and duration. Additionally, in the social image set, AOI 8 (bottom-right picture) was also viewed significantly more than other AOIs. Unlike the nonsocial image sets, AOI 4 did not demonstrate a significantly low number or duration of fixations.
- This preliminary evidence shows that placement of stimuli on a screen does have an effect on the amount of attention it elicits. These findings have implications for the design of technology which children use, including educational applications and augmentative and alternative communication devices.
- Further research is needed on the impact of age on viewing patterns and the impact of mix media on the screen.

References

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