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Infant Gaze Following During Parent–Infant Coviewing of Baby Videos

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A total of 122 parent–infant dyads were observed as they watched a familiar or novel infant-directed video in a laboratory setting. Infants were between 12–15 and 18–21 months old. Infants were more likely to look toward the TV immediately following their parents' look toward the TV. This apparent social influence on infant looking at television was not solely due to the common influence of the television program on looking behavior. Moreover, infant looks that were preceded by parent looks tended to be longer in length than those that were not preceded by parent looks, suggesting that infants assign greater value to media content attended to by their parents. Thus, parental patterns of attention to television may influence early viewing behavior.

Media have become increasingly integrated into the everyday lives of American infants and toddlers. According to parent reports, approximately 60% of children under the age of 2 years watch television for 1–2 hr each day (Barr, Zack, Garcia, & Muentener, 2008; Rideout & Hamel, 2006; Vanderwater et al., 2007; Zimmerman, Christakis, & Meltzoff, 2007). Although recent work has shown that children do not learn from screen media as well they do from real-life displays (see Anderson & Hanson, 2010), relatively less research has focused on how and why children under the age of 2 years pay attention to television. Given that many infants spend at least some of their video viewing time in the presence of a parent (e.g., Masur & Flynn, 2008; Rideout & Hamel, 2006), it is possible that parents' TV looking behavior may be a substantial influence on their infants' looking behavior. In the present research, we examined the social influence of coviewing

parents on their infants' looks toward and away from the TV screen.

Prior to the advent of infant-directed media, children under 2 years of age paid little and sporadic attention to television, beginning regular TV viewing at about 30 months (Anderson, Alwitt, Lorch, & Levin, 1979; Anderson & Levin, 1976; Anderson, Lorch, Field, Collins, & Nathan, 1986; see review and analysis by Anderson & Pempek, 2005). Recent reports, as cited above, suggest that contemporary children begin to show consistent interest in television well before 1 year of age. Huston and Wright (1983) posit that early attention to television is driven by the perceptual salience of the formal features of television like sound effects, character actions, and rapid cuts, irrespective of content comprehensibility. With additional screen experience as well as cognitive maturation, between the ages of 18 and 24 months children begin to rely less on formal feature salience and more on content comprehensibility (Anderson & Lorch, 1983; Huston & Wright, 1983; Lemish, 1987; Pempek et al., 2010; Richards & Cronise, 2000; Valkenburg & Vroone, 2004).

One limitation of this theory and research, however, is that there is little consideration of how influences other than cognitive maturation and experience with television may shape when and how

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young children attend to television. In particular, we examine here the parent as an influence on infants' attention to TV.

Social Influences on Attention to Television

Because infants and parents spend a substantial amount of time together with television, parents' viewing behavior could, in principle, have an impact on infant viewing behavior. Masur and Flynn (2008) report that for about half of infants, the television is on at least half of the time when parents engage in play with their children. Zimmerman et al. (2007) found that 59% of parents watch infant-directed videos with their child all or half of the time. Finally, Weber and Singer (2004) found that 47% of parents report watching every television show that their infant watches, and 39% report watching every video that their infant watches. Because these estimates do not consider coviewing with siblings, the actual amount of time an infant spends coviewing videos or television with a more experienced viewer may be greater than the numbers reported here.

When parents watch adult-directed programs with their children, it is clear that infants may be distracted from their object play and parent-child interactions are reduced in quantity and quality (Kirkorian, Pempek, Murphy, Schmidt, & Anderson, 2009; Schmidt, Pempek, Kirkorian, Lund, & Anderson, 2008). These findings extend to infant-directed TV programming (Courage, Murphy, Goulding, & Setliff, 2010; Pempek, Demers, Hanson, Kirkorian, & Anderson, 2011).

In contrast, Lemish and Rice (1986) found that the quality of interactions while watching television was similar to the interactions during book reading. The viewing context provided parents and children with a variety of rich experiences driven by the quality of content. That is, the more age-appropriate and educational the program, the higher the quality of interactions among parents and their infants. Similarly, Barr et al. (2008) found that for infants 12–18 months, higher levels of TV scaffolding by the parent (i.e., parental behaviors relating to TV content) resulted in higher levels of visual attention and responsiveness to the television content by the infant. Furthermore, Fidler, Zack, and Barr (2010) found that parental behaviors (e.g., pointing at the screen while watching TV) have more influence on attention during later infancy (15–18 months) than earlier infancy. Taken together, the research indicates that although the quantity and quality of parent-child interaction is reduced

during TV viewing, parents do use infant-directed videos as a basis for interaction and directing infant attention.

There is also some evidence to suggest that increased parent scaffolding behaviors may enhance infants learning from screen media. Fender, Richert, Robb, and Wartella (2010) examined the influence of parental coviewing on word learning among 12- to 25-month-old infants during coviewing of an infant-directed video intended to teach language. Results showed that children's repetition of the target words during coviewing varied as a function of parents' TV-related talk (i.e., the extent to which parents' language during coviewing was relevant to and corresponded with the language used in the video).

Parents' behaviors can also indirectly influence infants' television viewing behaviors. From ethnographic observations of parent-infant dyads, Lemish (1987) noted that children not only imitated acts on television during the 2nd year of life, but also parental behaviors like turning on the TV with a remote or flipping through the *TV Guide*. Importantly, Lemish also noted that infants were attracted to the television when their parents' attention was engaged by the TV.

Similarly, peer behaviors can influence older preschool children's television viewing. Anderson, Lorch, Smith, Bradford, and Levin (1981) found that 3- and 5-year-old children followed each other's looks toward and away from the television in a laboratory viewing situation. Analyses indicated that this gaze following was not due solely to the common influence over attention by the television program itself. Thus, it was not simply that the television attracted the children's attention simultaneously; there was a reciprocal social influence on looking toward and away from the TV.

Joint Visual Attention

In the present research we were interested in whether or not younger (12- to 15-month-olds) and older (18- to 21-month-olds) infants follow their parents' looks toward and away from the TV. There is reason to suppose that they might do so since by the end of their 1st year infants' gaze and preverbal vocalizations are influenced by parent behavior (e.g., Goldstein & Schwade, 2008). By 1 year of age, infants will follow the gaze of another toward an object (e.g., Bakeman & Adamson, 1984; Corkum & Moore, 1995, 1998; Scaife & Bruner, 1975). Research dedicated to examining the conditions under which joint visual attention can be elicited in infants has

shown that older children (18-month-olds) are more adept at gaze following than their younger counterparts (12-month-olds). Older infants tend to respond sooner to parental gaze shifts (Butterworth & Cochran, 1980; Butterworth & Jarrett, 1991; Moore & Corkum, 1998; Morissette, Richard, & Gouin-Decarie, 1995), they require fewer and less elaborate gestures to follow a gaze (Deák, Flom, & Pick, 2000), and they are less likely to be distracted by peripheral objects when following a gaze toward a target (Butterworth & Cochran, 1980; Butterworth & Jarrett, 1991).

Parental attempts to direct infant attention toward an object through gestures or verbalizations are considered attention scaffolding mechanisms (Bakeman & Adamson, 1984; Barr et al., 2008). In the case of coordinated looking at television, the more experienced television viewer may help guide the attention of the less experienced viewer (e.g., pointing to the screen and labeling an object when it appears on screen). In both 12- and 18-month-old infants, joint attention is increased when parents engage in these attention scaffolding behaviors (Deák et al., 2000). In particular, verbalizations that accompany behavioral gestures have been shown to lead to sustained episodes of joint visual attention in young children (Baldwin & Markman, 1989; Flom & Pick, 2003). In regard to television viewing, the findings of these studies are in concordance with those of Barr et al. (2008), which showed that infants whose parents engaged in attention scaffolding behaviors paid more attention to the television.

Overview of the Current Research

This research explored the possibility that infants use information from others' looks toward and away from the television as a means for guiding their own attention toward and away from the television. Where the current study diverges from much of the previous work on infant gaze following is that the parent-infant dyads were observed in a naturalistic, laboratory setting where parents were not instructed to try to elicit gaze following from their children.

On the basis of the literature on joint visual attention, our primary hypothesis was that in the 2nd year of life, infants follow their parents' looks toward the television. We hypothesized that infants in the older age group in our research (18–21 months) would follow parent looking more than infants in the younger age group (12–15 months). We also hypothesized that infant gaze following would increase the more parents overtly attempted to guide infants' attention

toward the screen (e.g., pointing toward the television screen or labeling an object on screen).

In addition to these hypotheses, we also addressed three research questions. The first question considered infant gaze following *away* from a target. Much of the research on joint attention has focused on infant gaze following to objects such as toys. Relatively less research has considered whether infants also follow the *termination* of looking at those objects. The present research not only examined the influence of looks toward the TV but also looks away.

The second research question addressed whether infant looks to the TV that were preceded by a parent look were longer than infant looks to the TV that were not preceded by a parent look. Prior research with infants, older children, and adults has shown that longer look lengths toward television are associated with greater cognitive engagement and learning (for a review, see Richards & Anderson, 2004). Thus, infants may use parents' looking as a cue to greater cognitive engagement with the TV content.

The third research question, addressed in the second set of analyses, focused on the effect of familiarity with the video on infant gaze following in parent-infant dyads. On one hand, one might expect to see greater infant look following in the parent-infant dyads that are not familiar with the video, as infants may look to parents for cues on how to direct their attention. On the other hand, one could imagine that familiarity with the video might lead to more infant look following, as parent and infant may have developed a viewing schema for the particular program.

Method

This research was part of a larger project that examined the effect of infant-directed videos on parent-child interactions. Only the methodology relevant to the current analyses is presented here. For more detailed methodological information, see Pempek et al. (2011).

Participants

A total of 122 parent-infant dyads participated. Ninety-four percent of the participating parents were mothers and 6% were fathers. None of the participating infants were reported as having vision or hearing difficulties. Participants were primarily Caucasian, with 82.8% of parents reporting

their infant's ethnicity as White, 3.4% as Hispanic, 3.3% as African American, 2.5% as Other, and 7.4% as multiracial. All infants were between 12–15 and 18–21 months of age. These age ranges were of particular interest because previous research on joint visual attention has shown substantial age differences within the 2nd year of life in terms of gaze following. In addition, there is relatively little published information about attention to television in children this young. A breakdown of the sample by age, gender, and assigned condition is provided in Table 1.

Setting and Apparatus

The laboratory TV viewing session took place in a 3.40 × 2.94 m room designed to resemble a typical family room. Furnishings included an armchair, a large pillow, a coffee table, a bookcase, a television stand, a 21-in. television, and a DVD player. For the child, a variety of age-appropriate toys including a shape-sorter, four rattles, a puzzle, a toy piano, toy kitchenware (i.e., a pot, a plate, a bowl, and a cup), a jack-in-the-box, stacking rings, a teddy bear, three books, and two types of blocks were provided. For the parent, a variety of magazines and a current newspaper were placed on the coffee table.

Laboratory sessions were videotaped using two video cameras. One camera remained stationary and was placed beneath the television stand. The second camera was placed in an adjacent room with a large one-way mirror and was operated by a researcher, allowing for more adaptive video recording. In addition to this second camera, the adjacent room included a video mixer that researchers used to toggle between camera views.

Stimuli

Baby Einstein is an infant-directed video series that implicitly encourages parent–infant interaction

through the labeling of on-screen objects. The two videos used were *Baby Monet: Discovering the Seasons* and *Baby Beethoven*. Both videos are approximately 30 min in length.

Sesame Beginnings is an infant-directed video series designed to enhance parent–infant interaction by explicitly modeling strategies that parents can integrate into everyday activities with their infants. The two videos used were *Beginning Together* and *Make Music Together*. Both videos are approximately 25 min in length.

Procedure

Families were mailed a letter describing the study and were then contacted via telephone to request participation. Participating families were randomly assigned to one of three video conditions: (a) *Baby Einstein* home viewing condition, (b) *Sesame Beginnings* home viewing condition, or (c) control condition (no experimenter-supplied videos viewed at home). Dyads assigned to the *Baby Einstein* or *Sesame Beginnings* home viewing conditions were sent the two DVDs from these respective series 2 weeks prior to visiting the laboratory and asked to coview each video with their infant (*Baby Monet* and *Baby Beethoven* for dyads in the *Baby Einstein* condition and *Beginning Together* and *Make Music Together* for the *Sesame Beginnings* condition). On average, dyads in the two home viewing conditions coviewed 12.75 times ($SD = 8.47$). Dyads in the control condition were not sent any videos and were not asked to coview anything specific during the time prior to the laboratory visit.

During their laboratory visit, parent–infant dyads in the *Baby Einstein* condition were shown either *Baby Monet* or *Baby Beethoven*. Parent–infant dyads in the *Sesame Beginnings* condition and in the control condition were shown either *Beginning Together* or *Making Music Together*. Dyads in the control condition were seeing a *Sesame Beginnings* DVD for the first time (verified because much of

Table 1
Breakdown of Sample by Condition and the Age and Gender of the Infant

Months	<i>Baby Einstein</i>		<i>Sesame Beginnings</i> (familiar)		<i>Sesame Beginnings</i> (unfamiliar)		Total
	Male	Female	Male	Female	Male	Female	
12–15	10	10	10	10	12	12	64
18–21	12	8	12	6	12	8	58
Total	22	18	22	16	24	20	122

the study was run before the videos were publicly available and by questionnaire from those parents who participated after the videos became available). The particular video shown during the laboratory session (of the two potential videos from each series) was counterbalanced within condition by the age and gender of the infant. Each laboratory session was videotaped for subsequent coding.

Parents were not given any specific instructions other than to interact with their infant as they normally would during video viewing at home. Both parents and infants were free to move around the room throughout the session. After viewing, parents were debriefed about the purpose of the study and given a small gift as a token of appreciation for their participation.

Videotape Coding

The primary dependent measures used here were derived from the coding of infant and parent looks toward and away from the television. Using a procedure adapted from Anderson and Levin (1976), Adobe Premiere video editing software was used to log look onsets and look offsets. In an additional pass, parents' attempts to guide infant attention to the television were coded (the "scaffolding" behaviors mentioned earlier). These behaviors were broken down into verbal (e.g., labeling an object on screen) or nonverbal (e.g., pointing to an object on screen). If a parent pointed to the screen and labeled an object, two separate interactions (one verbal, one nonverbal) were counted.

Twenty-five percent of the videotapes were double coded to measure interobserver reliability. For infant and parent looking, the intraclass correlation coefficients were .98 and .97, respectively. For parental attempts to guide infant attention to the television, the intraclass correlation coefficients were .90 for verbal behaviors and .82 for nonverbal behaviors.

Measures

Beyond descriptive measures involving looking at television and frequency of parent attempts to guide infant attention to the television, the larger concern of the current study was to quantify the interactions between infants and their parents. To do this, we reduced the data using sequential analysis, an analytic technique that lends itself to the extrapolation of events and event sequences from natural social interactions (Anderson et al., 1981; Bakeman & Gottman, 1997). Specifically, we

employed the use of conditional probabilities to capture sequences of attention coordination between infants and parents.

For a look toward the television to be considered part of an event sequence, it had to occur within 3 s following the initiation event. For example, an infant's look toward the television had to occur within 3 s following the parent's look toward the television to be counted as an instance of gaze following on the part of the infant. Use of the 3-s interval was incorporated to maintain consistency with past literature (i.e., Anderson et al., 1981). In addition, plots of distributions of lag times (i.e., how long it took an infant to follow a parent's look) did not indicate any clear threshold.

For each infant, eight proportions were calculated. Those measures were intended to estimate (a) the probability of an infant following his or her parent's look toward or away from the television, (b) the probability of an infant following an unrelated parent's look toward or away from the television, and (c) the probability of an infant following either his or her own or an unrelated parent's look toward or away from the television when the parent's data had been sequentially randomized. The randomization procedure was adopted to provide an estimate of the probability of an infant following an adult in any 3-s interval by chance, given that adult's frequency and length of looks at the TV. Each of these calculations will now be described in detail.

Infant following parent's look toward the television. To estimate the probability of an infant initiating a look toward the television within 3 s of the parent initiating a look, parent and infant looking onset and offset times were compared and one of three possible outcomes was assigned to each infant look onset: (a) no opportunity, (b) taken opportunity, and (c) failed opportunity. A look onset was coded as "no opportunity" if the infant was already looking at the television at the time that the parent initiated a look (i.e., the infant did not have the opportunity to follow the look because he or she was already looking at the screen), "taken opportunity" if the infant looked at the screen within 3 s of his or her parent initiating a look, and "failed opportunity" if a parent looked at the television and the infant failed to follow the look within 3 s. Next, the number of taken opportunities was divided by the total number of opportunities (i.e., taken opportunities + failed opportunities) resulting in the proportion of opportunities that the infant followed the parent's look toward the television within 3 s.

Infant following parent's look away from the television. To estimate the probability of an infant terminating a look toward the television within 3 s of his or her parent terminating a look, times of parent and infant look onsets and offsets were again compared and one of three possible outcomes was assigned to each infant look offset: (a) no opportunity, (b) taken opportunity, and (c) failed opportunity. A look offset was coded as "no opportunity" if the infant was already looking away from television at the time that the parent terminated a look (i.e., the infant did not have the opportunity to follow the parent's look termination because the infant was already looking away), "taken opportunity" if the infant looked away from the screen within 3 s of the parent terminating a look, and "failed opportunity" if a parent looked away from the television and the infant failed to look away within 3 s. Next, the number of taken opportunities was divided by the total number of opportunities (i.e., taken opportunities + failed opportunities) resulting in the proportion of opportunities of an infant following a parent's look away from the television within 3 s.

Infant following an unrelated parent's looks toward and away from the television. One possible reason that parent and infant looks might coincide is that their attention is synchronized by the common organization of attention by the television program they are watching. To account for this possibility, we estimated the probability of an infant looking toward or away from the television within 3 s of an unrelated parent who watched the same program with his or her own child on a separate occasion. Data for these artificial dyads were produced by "pairing" each infant with the parent of another infant of the same age and gender who had been assigned to the same video viewing condition and who had been shown the same video during the laboratory viewing. The same procedure described earlier was used to estimate the probability of an infant following the looks toward and away from the television of an unrelated parent.

Randomized probabilities. The final four probabilities were estimated using the same conditions as described earlier. Instead of comparing the infant looking data to actual parent and unrelated parent data, we compared it with sequence-randomized parent and unrelated parent looking data. For each adult viewer, the sequence of looks and nonlooking pauses was randomized. This procedure maintained the parents' overall looking time, number of looks, and look lengths. Each infant look file was compared with the random sequence look file of his or

her own parent as well as to the unrelated parent with whom he or she had been previously matched. Using this method, four new probabilities were estimated: (a) the probability of an infant following parent looks to the television when the parent's look sequence has been randomized, (b) the probability of an infant following parent looks away from the television when the parent's look sequence has been randomized, (c) the probability of an infant following an unrelated parent's looks toward the television when the unrelated adult's look sequence has been randomized, and (d), the probability of an infant following an unrelated parent's looks away from the television when the unrelated adult's look sequence has been randomized.

Results

Although the experiment from which these data were taken was conceived as a single study, for present purposes we separated the analyses by each video series. We did this because *Baby Einstein* videos and *Sesame Beginnings* videos are quite different from each other in their use of narrative, dialogue, music, and production techniques. Moreover, the no-video control group was shown *Sesame Beginnings* for the first time in the laboratory session, which allows for the comparison of experienced viewers of the videos to novice viewers.

Across the parent-infant dyads in both studies, there was a moderately strong correlation between overall amount of parent and infant looking within dyads, producing a significant correlation within and across each condition, overall $r(120) = .63$, $p < .001$. Despite this relatively strong similarity within parent-infant dyads, there was substantial variability across dyads in how much parents and infants looked at the TV, with parent percent looking ranging from 2% to 91% and infant percent looking ranging from 2% to 83%. The within-dyad correlation was an indication that there may be a substantial social influence on infants' attention to infant-directed media content. To examine this possibility, the conditional probabilities calculated for each infant were compared using mixed model analyses of variance (ANOVAs). All significant main effects and interactions were followed up with Bonferroni-corrected pairwise comparisons. Because we had no specific hypotheses related to the gender of the infant, this variable was not included in the analyses. All the proportions were square root transformed prior to analysis to approximate a

normal distribution, although analysis of the raw values did not yield a different pattern of results.

Baby Einstein

The data for infant following of look onsets and infant following of look offsets were included in two separate 2 (age: 12–15 or 18–21 months) $\times$ 4 (proportion: related parent, related parent random, unrelated parent, and unrelated parent random) mixed model ANOVAs. Untransformed mean proportions are presented in Table 2.

For infant following of look onsets, the mixed model ANOVA yielded a significant main effect of proportion, $F(3, 114) = 39.87$, $p < .001$, $\eta^2 = .51$. Bonferroni-corrected pairwise comparisons revealed that the Related Parent proportion was significantly greater than its randomized counterpart (mean difference = .17, $SE = .02$), $t(36) = 5.97$, $p < .001$, $d = .95$, and that the Unrelated Parent proportion was marginally greater than its randomized counterpart (mean difference = .05, $SE = .02$), $t(36) = 6.06$, $p = .055$, $d = .97$. Together, these findings show that infants' look onsets were associated with their own parent's look onsets as well as with features of the television program and beyond what would be expected by chance. Furthermore, the Related Parent proportion was greater than the Unrelated Parent proportion (mean difference = .13, $SE = .02$), $t(36) = 6.06$, $p < .001$, $d = .97$, which indicates that the influence of parents' look onsets on infant look onsets went above and beyond what would be expected by the common organizing influence on looking behavior by the TV program. There were no significant effects involving age of infant.

For infant following of look offsets, the parallel mixed model ANOVA yielded a main effect of proportion, $F(3, 114) = 6.52$, $p < .001$, $\eta^2 = .15$, qualified by a nearly significant interaction of age and proportion, $F(3, 114) = 2.67$, $p = .051$, $\eta^2 = .07$. Bonferroni-corrected pairwise comparisons revealed that these significant F tests were the result of greater following of look offsets in the 12- to 15-month-old infants, than in the 18- to 21-month-old infants. Specifically, for this younger age group, the Related Parent proportion was greater than both its randomized counterpart (mean difference = .22, $SE = .049$), $t(36) = 2.59$, $p < .001$, $d = .41$, and the Unrelated Parent proportion (mean difference = .17, $SE = .05$), $t(36) = 2.59$, $p = .004$, $d = .41$. Thus, for the *Baby Einstein* condition, 12- to 15-month-old infants' look offsets were influenced by their parents' look offsets above and beyond what would be

expected by chance as well as by the common organization by the formal features of the television. For the older infants, there was no evidence that their looks away from the screen were influenced by their parent or by the formal features of the program (all $ps > .90$).

Infant look lengths. Next, we wanted to examine this phenomenon further to see if the attention coordination translated into something more directly meaningful in terms of the infants' cognitive processing. On the basis of the hypothesis that longer look lengths reflect greater cognitive processing (for a review, see Richards & Anderson, 2004), we used a paired-samples t test to compare the length of infant looks toward the television that followed parent look onsets with the length of looks toward the television that did not follow the parent look onsets. Consistent with the previous literature (Richards & Anderson, 2004), infant look lengths were lognormally distributed and therefore the geometric mean of look lengths was used for this analysis. The results of the t test showed that overall, infant looks that were preceded by a parent look tended to be longer ($M = 3.67$ s, $SD = 2.76$) than looks not preceded by a parent look ($M = 2.87$ s, $SD = 1.30$), $t(39) = 2.01$, $p = .05$, $d = .32$. The corresponding arithmetic means were 8.85 s ($SD = 6.94$) for look lengths following parent looks and 7.80 s ($SD = 6.91$) for looks not preceded by a parent look.

Parent scaffolding. Thus far, the analyses indicate that infants follow parent looks at *Baby Einstein* and that this following is not solely due to the common influence on both viewers by attention-eliciting features of the program, and that infant looks initiated soon after a parent look onset are sustained longer than looks without this social component. We also examined whether or not parental scaffolding behaviors were associated with increased coordination of looks toward the television on the part of the infants. To start, we fit a regression model that included parent verbal behaviors and parent nonverbal behaviors as predictors. Regardless of the order in which the two predictors were included in the model, the results showed that only parents' verbal scaffolding behaviors were predictive of look onset following by the infants, $\beta = .027$, $SE = .011$, $t = 2.45$, $p = .018$, $r^2 = .14$.

Given that verbal encouragement from parents was predictive of the amount of look following among infants, one plausible conclusion is that parental encouragement is the sole impetus for the look following phenomenon. To ensure that infants' attention was not being influenced merely by

Table 2
Untransformed Look Following Proportions by Age and Video Condition

	Look onsets						Look offsets					
	Baby Einstein (familiar)			Sesame Beginnings (familiar)			Sesame Beginnings (unfamiliar)			Baby Einstein (familiar)		
	12-15 months	18-21 months	Proportion	12-15 months	18-21 months		12-15 months	18-21 months		12-15 months	18-21 months	18-21 months
Infant following parent's looks (natural)	.293 (.177)	.424 (.186)	.391 (.169)	.296 (.176)	.213 (.129)	.275 (.103)	.525 (.222)	.363 (.183)	.340 (.166)	.378 (.164)	.395 (.149)	.404 (.164)
Infant following randomized parent's looks (natural random)	.140 (.102)	.212 (.139)	.183 (.117)	.162 (.105)	.122 (.113)	.140 (.076)	.285 (.172)	.314 (.160)	.294 (.156)	.335 (.195)	.452 (.241)	.339 (.232)
Infant following unrelated adult's looks (artificial)	.189 (.151)	.262 (.159)	.242 (.148)	.205 (.124)	.153 (.125)	.202 (.103)	.345 (.211)	.306 (.139)	.277 (.137)	.377 (.194)	.378 (.148)	.358 (.176)
Infant following randomized unrelated adult's looks (artificial random)	.152 (.161)	.217 (.133)	.202 (.105)	.162 (.119)	.131 (.098)	.171 (.095)	.370 (.236)	.348 (.177)	.347 (.146)	.345 (.213)	.410 (.208)	.385 (.217)

Note. Standard deviations are in parentheses.

parents' verbal encouragement, these data were included in a hierarchical multivariate outcomes model (Brennan, Kim, Wenz-Gross, & Siperstein, 2001; Supovitz & Brennan, 1997), which allowed us to compare the Related Parent proportion and Related Parent Random proportion while controlling for parent verbal encouragement. Even controlling for parent verbal encouragement, the Related Parent proportion was greater than the Related Parent Random proportion $\chi^2(1) = 38.43$, $p < .001$. Thus, although parents' verbal encouragement is predictive of an increase in infant following of look onsets, infants do not require such encouragement to exhibit look following.

Summary

These analyses demonstrate that infants follow their parents' looks toward *Baby Einstein* above and beyond what would be expected by chance or as a result of the common organization of looks by the television and regardless of the age of the infant. Infant looks that were preceded by a parent look tended to be longer than looks that were not preceded by a parent look; therefore, infants may assign more importance to program content that succeeds a parent look versus program content that does not. Moreover, parents' verbal attempts to guide infant attention to the television were predictive of increased infants' following of look onsets. Finally, infant following of parent look offsets did vary by age, as older infants were less likely to follow a look away from the TV than the younger infants.

In the next set of analyses, we asked the same series of questions with data from two additional groups of infants. The purpose of these analyses was twofold: One, they served as a replication of the analyses conducted with the *Baby Einstein* data to demonstrate that infant look following is not specific to the form and content of the *Baby Einstein* videos; two, these analyses examined whether or not infant look following varies as a function of infant familiarity with the video.

Sesame Beginnings

Two groups of parent-infant dyads saw *Sesame Beginnings* in the laboratory. One group was familiar with program, having had the DVDs at home for the 2 weeks prior to the laboratory visit. The second group was seeing the program for the first time. Thus, in addition to including infant age as a between-subjects variable, we also included famil-

ilarity with the video as a factor in the models (a $2 \times 4 \times 2$ ANOVA).

For infant following of look onsets there was a main effect of proportion, $F(3, 324) = 66.89$, $p < .001$, $\eta^2 = .46$. There were no effects of infant age or familiarity with the video. Bonferroni-corrected pairwise comparisons revealed that across dyads, the Related Parent proportion was greater than its randomized counterpart (mean difference = .16, $SE = .01$), $t(76) = 6.96$, $p < .001$, $d = .77$, and that the Unrelated Parent proportion was greater than its randomized counterpart (mean difference = .04, $SE = .01$), $t(76) = 6.96$, $p = .004$, $d = .77$. Moreover, the Related Parent proportion was greater than the Unrelated Parent proportion (mean difference = .10, $SE = .01$), $t(76) = 6.96$, $p < .001$, $d = .77$. Thus, although infants were influenced by both their parent's looks toward the television and the formal features of the program, the influence of the parent was significantly greater. For infant following of look offsets, there were no main effects or interactions in the mixed ANOVA.

Infant look lengths. As with the *Baby Einstein* data, we examined if infants' look lengths varied by whether or not they were preceded by a parent look. Again, the geometric mean was used as the outcome measure because the look lengths were distributed as lognormal. Results showed that infant looks that were preceded by a parent look ($M = 1.92$ s, $SD = .54$) were significantly longer than looks that were not preceded by a parent look ($M = 1.74$ s, $SD = .45$), $t(79) = 3.80$, $p < .001$, $d = .42$. The corresponding arithmetic means were 7.48 s ($SD = 4.60$) for looks following parent looks and 7.09 s ($SD = 4.97$) for looks not preceded by a parent look.

Parent scaffolding. To examine the relation between infant following of look onsets and parents' encouragement, we ran a linear regression with both verbal and nonverbal attempts to guide attention as predictors. Familiarity with the video was not included as a factor in these analyses because group differences could simply arise as a function of group differences in baseline looking, rather than actual differences in our outcome of interest. Similar to what was found for *Baby Einstein*, regardless of the order in which the predictors were entered into the model, only parents' verbal encouragement was a significant predictor of infant following of look onsets, $\beta = .042$, $SE = .01$, $t = 4.37$, $p < .001$, $r^2 = .20$.

To ensure that the look following was not solely due to parents' verbal encouragement, these data were also included in a hierarchical multivariate outcomes model and the Related Parent proportion

was compared to the Related Parent Random proportion, controlling for parents' verbal encouragement. Here, because the Related Parent Random proportion was included in the model and therefore controlled for, infant familiarity with the videos was also included as a predictor. The initial model included a familiarity by parents' verbal encouragement interaction term; however, this was not significant and subsequently trimmed from the model. Even controlling for parental verbal attempts to guide attention, the gaze following in the parent-infant dyads was significantly greater than what would be expected due to chance for the experienced *Sesame Beginnings* group, $\chi^2(1) = 40.26$, $p < .001$, and marginally greater than what would be expected due to chance for the inexperienced group, $\chi^2(1) = 3.00$, $p = .079$.

Discussion

Infants' looking at infant-directed videos was predicted by their parents' looks at the same videos. Specifically, when parents looked at the TV, infants followed their look onsets. This gaze following extended beyond the common organization on both parent and infant attention by the television program and well beyond what would be expected by chance. Furthermore, these socially influenced looks at TV were of longer duration than looks at the TV that did not follow the parents' looks. These results were found for two very different infant-directed video series that incorporated differing production styles, narrative structure, music, and dialogue. The parents' social influence on infant looking at the television was also found irrespective of the infants' familiarity with the videos.

Contrary to our hypothesis that older infants would be more likely to follow looks toward the television, we found no age differences in the likelihood of infants' following parents' looks toward the television. One possibility for this lack of an age difference is that the target in this case (TV) was especially dynamic and salient compared to targets typically used in other research on gaze following. This may result in the younger infants being more likely to follow a parents' gaze toward a TV screen compared to passive objects used in other research. This is in line with some previous literature showing that the more dynamic a target, the more readily infants will follow a gaze toward it (Corkum & Moore, 1998). This explanation is also consistent with Huston and Wright's (1983) theory that younger infants are relatively more influenced by formal

features of TV that are salient and dynamic in nature.

Parents' attempts to guide infant attention verbally (e.g., by labeling an object on screen) were predictive of increased look onset following by infants. However, parents' attempts to guide infant attention nonverbally (e.g., by pointing at the screen) were not. Although parents' verbal and nonverbal attempts to guide attention were moderately correlated ($r = .63$), verbal attention guidance may have been more effective simply because the infant did not actually have to be looking at the parent. Nevertheless, the look following phenomenon occurred above and beyond parents' verbal encouragements to view the program. These findings are broadly consistent with the joint attention literature and extend this literature to a situation commonly found in homes of young children: co-viewing infant-directed videos. The study also extends the joint attention findings to a more naturalistic situation where the parent has not been instructed to visually engage with an object.

With regard to the literature on infants and television, the findings of this study are in line with hypotheses of Barr et al. (2008), namely, that parents can and do scaffold their infants' attention to the television. The present results are also consistent with observations by Anderson et al. (1981) that 3- and 5-year-old preschoolers followed peers' look onsets and offsets even after the common influence by the TV program was considered. Thus, gaze following during television viewing appears to continue at least through the preschool years.

Although the present study found that infant following of look onsets takes place in the presence of infant-directed programming, it should be noted that this phenomenon does not likely extend to adult television content. Using data from Kirkorian et al. (2009), we analyzed toddler following of parents' looks toward adult-directed programming and found no evidence of look following in 12-, 24-, and 36-month-old children (Demers & Anderson, 2010). Infants and toddlers may be sensitive to the child-directedness of the content and it is apparent that parents behave quite differently in the presence of infant-directed videos than they do in the presence of adult-directed media. Thus, gaze following during a TV viewing session by infants appears to be appropriately context sensitive.

Familiarity with the *Sesame Beginnings* videos, however, did not influence gaze following. It remains unclear why familiarity had little apparent influence, especially as we have found in this data set that parent-child interactions were influenced

by familiarity with and regular coviewing of the program. Specifically, coviewing the videos at home predicted increased parent-child engagement during a non-TV play session (Pempek et al., 2011). This change in parenting behavior may simply have not been sufficient to influence the already strong phenomenon of infant gaze following.

The literature on infant cognitive processing of television indicates that overall, comprehension is quite poor at least until about 30 months of age (for recent reviews see Anderson & Hanson, 2010; Courage & Setliff, 2010). Given this observation, what might be the function of gaze following to television? As children grow older, their looks at television become increasingly cued by features such as children's voices, animation, puppets, and the like (Alwitt, Anderson, Lorch, & Levin, 1980; Anderson & Levin, 1976; Levin & Anderson, 1976; Schmitt, Anderson, & Collins, 1999). Children use these features to divide their attention between toy play and TV viewing such that by age 5 years, their comprehension does not suffer as compared to a viewing situation in which toys are not available (e.g., Lorch, Anderson, & Levin, 1979). Theories of the development of television viewing have hypothesized that children gradually learn that certain features of television (such as peculiar voices) are predictive of child-oriented and comprehensible content (Anderson & Lorch, 1983; Huston & Wright, 1983). The present results suggest that, during coviewing sessions in infancy, parents' looks at television, as well as verbal comments about the TV program, may play a significant role in teaching their infants how to watch television. At the very least, parents may overtly (with verbal prompts) and covertly (by their own looking behavior) cue their children as to when attention is most likely to be rewarded by interesting and comprehensible content.

How might infants benefit from following parents' looks at TV? Infant looks toward the television that are preceded by a parent look are longer than looks that are not preceded by a parent look. Prior research has shown that longer looks at television are indicative of deeper cognitive processing and are associated with greater comprehension and memory for program content (for a review, see Richards & Anderson, 2004). The fact that infants' looks are longer when they are preceded by a parent's look onset is suggestive that infants may assign more significance to the succeeding content and may thus process that content more completely. In essence, parent looking behavior may alert the infant to potentially relevant and compre-

hensible content and may therefore be a factor that can facilitate infant comprehension.

It is not surprising that the findings for infants following parent looks away from the TV were weak and inconsistent. By definition, infants were in the process of looking at the TV, so they may literally have not seen the parent look away. Nevertheless, we did find evidence of infant following parents' looks away from the *Baby Einstein* videos, but not the *Sesame Beginnings* videos. We have no compelling explanation for this difference, but it should be pointed out that the *Baby Einstein* videos are constructed as brief clips of toys moving, dogs running, babies laughing, and the like. There is no particular cognitive reason to maintain attention from shot to shot insofar as any given shot has no relation to the succeeding shot. *Sesame Beginnings*, however, has a narrative structure, and actions unfold across shots in a manner that is conventional in television. Also, on the whole, some of the shots in the *Sesame Beginnings* videos were much longer than those in the *Baby Einstein* videos. To the degree to which infants were able to at least partially comprehend the narrative and thus become cognitively engaged with the content, there was greater reason during *Sesame Beginnings* not to follow the parent's look away from the screen.

Limitations and Future Research

The primary limitation to this research is that the findings are correlational and not based on experimental manipulations of parent looking behavior. That said, we believe we have provided compelling evidence that the gaze following was not due to temporal coincidence or to common organization of attention by the TV content.

Furthermore, unlike much of the previous work on gaze following in infants, we did not carefully control parent and infant positioning relative to the target. This may have limited gaze following in some infants who positioned themselves in such a way that they could not readily see their parents' gaze. As such, the phenomenon may even be stronger than what we have shown in this research.

Engaged parent coviewing of infant videos may possibly have longer term consequences that should be explored in future research. Longitudinal follow-up of infant gaze following to objects during an object-labeling task found that gaze following frequency and associated look duration positively predicted later vocabulary (Brooks & Meltzoff, 2008). It remains to be seen whether or not such a result

may be found with respect to infant gaze following while coviewing infant-directed television.

This potentially positive aspect of parent-child coviewing of infant-directed videos should be placed in the context that several investigations have found associations of baby video viewing with poorer cognitive and language development as well as reduced parent-child interactions at home (Christakis et al., 2009; Mendelsohn et al., 2008). These findings have led to a renewed cautionary recommendation by the American Academy of Pediatrics of no TV exposure for infants under 2 years of age (American Academy of Pediatrics, 2011). Nevertheless, most infants watch television, often with parents. The present research shows that what infants attend to when they are watching infant-directed TV is influenced by their parents' attention to the TV.

Conclusion

To comprehend television, children must learn to apply their attention efficiently. Over time, infants have to learn when and where to look on the screen, they have to learn how to identify age-relevant and comprehensible content, and they have to learn how to comprehend transitions between shots as well as the content conveyed by those shots (Anderson & Hanson, 2010). Much of this learning, of course, comes from exposure to television and presumably requires little direct instruction. Nevertheless, parent coviewing behaviors include not only overt behaviors such as verbal labeling and pointing but also less overtly, their own patterns of looking at and away from the screen. Parent coviewing may thus provide an important bootstrapping experience that helps infants pay systematic and selective attention to television content.

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