

Television Viewing Patterns in 6- to 18-Month-Olds: The Role of Caregiver–Infant Interactional Quality

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The present study examines coviewing of *Baby Mozart* by 6- to 18-month-old infants and their caregivers under naturalistic conditions. We had two questions. First, extending the method of Barr, Zack, Garcia, and Muentener (*Infancy*, 13 [2008], 30–56) to a younger population, we asked if age, prior exposure, and caregiver verbal input would predict infant looking to a *Baby Mozart* video from 6 to 18 months. Second, we asked if caregiver–infant interactional quality, defined as the amount of shared focus and turn taking between infant and caregiver, would be associated with infant looking time. We found that, in addition to the anticipated effect of prior exposure and caregiver verbal input, interactional quality measures were related to infant media-directed looking. Infants who engaged in more shared focus and turn taking looked more to the program than infants who interacted less with their caregivers. These results are discussed in terms of social mediation of coviewing during early infancy.

In recent years, the availability and use of infant-directed media has increased substantially. During the 1990s, approximately 17% of children younger than 1 year of age were exposed to television and videos, while in recent years that number has increased to more than 50% (Anderson & Pempek, 2005; Courage & Setliff, 2009; DeLoache & Chiong, 2009;

Rideout & Hamel, 2006; Zimmerman, Christakis, & Meltzoff, 2007b). In children under 2 years of age, it is currently estimated that 68% watch television on an average day (Vandewater et al., 2005). Moreover, a growing number of programs are being targeted specifically at young infants (e.g., *Baby Einstein* and *Brainy Baby*), with sales of *Baby Einstein* videos alone being estimated at \$200 million in 2005 (Bronson & Merryman, 2006). These figures are of interest in light of recent suggestions that early media viewing may be detrimental for young children (e.g., Zimmerman, Christakis, & Meltzoff, 2007a) and the recommendation of the American Academy of Pediatrics (1999) that children under 2 years of age not be exposed to television at all. The combination of possible negative outcomes with the decreasing age of first exposure makes it important to investigate both the effects of media viewing on infants and caregivers, as well as how these programs are being used during coviewing. Previous research has focused on the amount and content of media exposure with far less empirical attention to the context of media viewing during infancy (Christakis, 2009). In what follows we will address each of these topics in turn.

Learning and imitation from television during infancy

Recently, researchers have increasingly examined the effects of television exposure on infants and caregivers. First, findings from studies on learning and imitation from television have suggested that infants learn less effectively from televised models when compared with live ones; this has been termed the *video deficit effect* (Anderson & Pempek, 2005). Robb, Richert, and Wartella (2009), for example, assessed word learning in 12- to 15-month-old infants from *Baby Wordsworth*, a video in the *Baby Einstein* series designed to teach children a set of 30 specific vocabulary items. The home-viewing group watched the video 15 times over 6 weeks but did not show improved production or comprehension of these words when compared with controls. By contrast, time spent sharing books was associated with an increase in both receptive and expressive knowledge of the vocabulary list. In a similar study, DeLoache et al. (2008) found that the vocabulary knowledge of 12- to 18-month-olds did not increase as a result of DVD viewing, when compared with controls. A group exposed to the same set of words by their caregivers, however, did show increased knowledge of the vocabulary. These findings build on earlier research suggesting that children learn less effectively from video than from live models in infancy (Barr & Hayne, 1999; Kuhl, 2007; Kuhl, Tsao, & Liu, 2003; Mumme & Fernald, 2003; but see Vandewater, Park, Lee, & Barr, 2008).

Caregiver–infant interactions during media viewing

In another vein, research on the effects of television exposure on infant and caregiver behavior has shown that the amount of caregiver–infant interaction is reduced when the television is on (Kirkorian, Pempek, Murphy, Schmidt, & Anderson, 2009; Mendelsohn et al., 2008; Pempek, Demers, Anderson, & Kirkorian, 2007) and that background television disrupts infant toy play, even when the child is not overtly watching (Schmidt, Pempek, Kirkorian, Lund, & Anderson, 2008). Kirkorian et al. (2009), for example, observed 12-, 24-, and 36-month-old infants and their caregivers interacting in a naturalistic setting for 30 min with the television on and for 30 min with it off. They found that both the quantity and quality of the caregiver–infant interactions were reduced when the television was on. Similarly, Mendelsohn et al. (2008) found that caregivers, predominantly low-income Latino parents, only reported interacting with their 6-month-old infants during one quarter of all coviewing episodes, although they were more likely to interact during the coviewing of educational programming (42% of the time). Finally, Schmidt et al. (2008) observed children playing with toys while an adult-directed television program played in the background. They found that the 12- to 36-month-old infants engaged in fewer episodes of toy play and exhibited reduced periods of attention to toy play when the television was on, even though the children were not apparently watching it.

Infants' attention to television

A final body of research on the processing of television in infancy suggests that attention to television is influenced by the child's prior exposure to specific content and is mediated by formal features, such as sound effects and television editing techniques (Barr, Wyss, & Somanader, 2009; Calvert & Scott, 1989; Huston & Wright, 1983; Rice, Huston, & Wright, 1982; Schmitt, Anderson, & Collins, 1999). Huston and Wright (1983) predicted that with repeated exposure to specific content, children's looking time to television would be maintained or increase because they begin to acquire knowledge about the formal features of the program. Over time, this learned information helps children to reorient and maintain attention across a televised narrative. Consistent with this hypothesis, subsequent research has found that comprehension and attention do increase with repeated exposure to content in both infants and toddlers (Anderson & Levin, 1976; Anderson, Lorch, Field, & Sanders, 1981; Crawley, Anderson, Wilder, Williams, & Santomero, 1999; Lemish, 1987; Richards & Gibson, 1997). Richards and Gibson (1997), for example, found that 6-month-olds developed a familiarity preference for televised content after a relatively short exposure to a noninfant-

directed program. Barr, Zack, Garcia, and Muentener (2008) also found that 12- to 18-month-old infants with prior exposure to specific content had significantly higher levels of looking time and responsiveness to infant-directed programming.

Caregiver's role in infant television viewing

More empirical attention should be devoted to examining the nature of the interactions that take place during coviewing of infant-directed programming, as these interactions may significantly influence what infants extract from the viewing experience (see also Christakis, 2009; DeLoache & Chiong, 2009). In order to investigate the relations between caregiver verbal input and infant looking to television, Barr et al. (2008) observed coviewing of *Baby Mozart* and *Kids' Favorite Songs 2* with 12-, 15-, and 18-month-old infants. Based on Vygotskian theory, Barr et al. argued that caregivers mediate their children's processing of televised content and scaffold their television viewing. From a Vygotskian perspective, social experiences are central to all cognitive development, and social cues provided during joint interactions are essential to word learning and knowledge acquisition (for a review, see Baldwin & Moses, 2001). Thus, the caregiver's verbal style (i.e., the level of scaffolding s/he provided during coviewing) was predicted to influence the looking time and responsiveness of the child. Consistent with this social mediation of viewing theory, Barr et al. found that when caregivers provided higher proportions of DVD-related utterances, especially questions and labels or descriptions, this was associated with increased looking to the media and responsiveness by infants. The relations between caregiver style and infant looking and responsiveness also changed with age. Older toddlers increased their looking time and responsiveness during both medium and high scaffolding, while increased looking time and responsiveness by 12-month-olds was only associated with high scaffolding. These findings are also in line with earlier research suggesting the important role of caregivers in guiding children to an understanding of television as a symbolic medium during infancy and toddlerhood (Warren, 2003).

The present study

The present study extends the method of Barr et al. (2008) to a younger population, with an increased focus on the role of caregiver–infant interactions as a predictor of infant looking to the media. First, comparing 6-, 9-, 12-, 15-, and 18-month-olds, we asked whether caregiver verbal input (defined as the caregiver's proportion of media-related questions and labels or descriptions) and prior exposure to the content would dif-

fer in younger infants compared with older ones. This downward extension to 6- and 9-month-olds was suggested by the increasing exposure of children under 12 months of age to television (Anderson & Pempek, 2005), by the relative lack of research on factors associated with television exposure in children under 12 months (Anderson & Pempek, 2005; Christakis, 2009; Courage & Setliff, 2009; DeLoache & Chiong, 2009; Garrison & Christakis, 2005), and by the reduced effect of scaffolding on infant looking found in 12-month-olds by Barr et al. (2008). Second, we were interested in whether differences in caregiver–infant interactions might be associated with infant looking to the media over and above the associations with prior exposure and caregiver verbal input. To this end, we adapted two measures of caregiver–infant interactional quality from Laible and Song (2006). *Shared focus* was defined as the degree to which the infant and caregiver were “on the same page” during coviewing, sharing instances of warmth and interest regarding the media content. *Turn taking* was defined as the amount of back-and-forth the dyad engaged in while watching the presentation, engaging in either verbal or nonverbal exchanges with regard to the media. Based on the social mediation theory of viewing described above, we reasoned that increased levels of caregiver–infant engagement during coviewing would result in increased levels of infant looking to the media, in addition to the role of the caregiver’s verbal contributions.

Thus, the present study measured 6-, 9-, 12-, 15-, and 18-month-olds’ looking time to a 13-min clip of *Baby Mozart* during caregiver–infant coviewing at home. We expected looking time to be predicted by the infant’s age and prior exposure to the program, the proportion of the caregiver’s media-directed questions and labels or descriptions, and the quality of the interaction between infants and caregivers as defined by their levels of shared focus and turn taking.

METHOD

Participants

One hundred ten 6-, 9-, 12-, 15-, and 18-month-old (60 boys) full-term healthy infants and their caregivers were recruited through commercially available mailing lists and by word of mouth. Twenty-three infants (15 boys) were 6-months old ($M = 6.61$ months, $SD = .36$ months), 24 infants (13 boys) were 9 months ($M = 9.65$ months, $SD = .51$ months), 23 infants (15 boys) were 12 months ($M = 12.72$ months, $SD = .40$ months), 20 infants (11 boys) were 15 months ($M = 15.39$ months, $SD = .37$ months), and 20 infants (6 boys) were 18 months ($M = 18.64$ months, $SD = .23$ months).

In a cross-experiment comparison, the 15- and 18-month-old infants in this study had also participated in the study reported by Barr et al. (2008). Caregivers were predominantly mothers (95 = mothers, 3 = fathers, 9 = both parents or a parent and a grandparent, and 3 = grandparents) and were English speaking. At the time of the study, 40.9% of infants had one or more older siblings and 41 infants had a sibling present during the coviewing observation. Participants were African American ($n = 5$), Asian ($n = 3$), Caucasian ($n = 82$), of mixed descent ($n = 17$), and not reported ($n = 3$). The majority of infants were from middle- to upper-class, highly educated families. Their caregivers' mean educational attainment was 17.03 years ($SD = 1.29$) based on 99.1% of the sample, and their mean rank of socioeconomic status (Nakao & Treas, 1992) was 76.25 ($SD = 12.86$) based on 96.4% reporting. Twenty additional infants were excluded from the final sample due to experimenter error or interference ($n = 11$), equipment failure ($n = 7$), caregiver absence for part of the presentation ($n = 1$), and infant sleepiness ($n = 1$).

Materials

Baby Mozart video

Caregiver–infant dyads watched a portion of a *Baby Mozart* video from the *Baby Einstein* series. In *Baby Mozart*, simple toys are manipulated in time to the music of Mozart. Infants were shown from the beginning of Scene 3 to the end of Scene 6; the video presentation lasted 12 min, 57 sec.

Caregiver questionnaire

Caregivers were asked to provide demographic information, such as occupation, ethnicity, educational attainment, and languages spoken at home. Caregivers were also asked to estimate their typical daily household television use. They were asked to respond on a four-point scale (*never/very rarely/once in a while/almost always*) about how often they talked with their infant during television viewing. Finally, parents were asked to indicate whether their infants had previously been exposed to a video in the *Baby Einstein* series (prior exposure group) or not (no prior exposure group).

Procedure

Many of the participants in this study participated in other studies reported elsewhere. Caregiver–infant dyads were visited in their homes and tested under naturalistic conditions. We described the study to and

obtained informed consent from the caregiver. We informed caregivers that we were examining how infants attend to and respond to infant-directed programming and asked caregivers to interact with their infants during the video presentation as they typically would when viewing television. We did not inform caregivers that we were specifically interested in caregiver–infant interaction patterns. If caregivers asked whether or not they could speak to their infant, we answered that they should behave as they normally would while their infant viewed television, with the restriction that they remain in the room during the video presentation. Caregivers and infants were video-taped during the video presentation such that infant’s faces and eyes were visible at all times. Siblings or other family members were also permitted to watch, as this would be representative of the infant’s normal viewing environment. Following the video presentation, an experimenter administered the caregiver questionnaire. Each visit lasted approximately 30 min.

Coding

Infant looking time

Percent looking time, measured from the video-taped sessions, was defined as the percentage of time the infant spent looking at the television screen across all segments (Anderson & Levin, 1976). Due to some variations in in-home recording, this was calculated by dividing the infant’s total looking time by the total time recorded. Percent looking time was used as the primary outcome measure. A Pearson product–moment correlation yielded an interobserver reliability coefficient of .94 based on 28.6% of the sessions for 6- to 12-month-olds (for reliability for older ages, see also Barr et al. 2008). We also calculated mean length of infant looks, the number of looks, and maximum length of look (see Table 1).

Caregiver verbalizations

The categories coded for this study were defined by Barr et al. (2008) based on previous book-reading studies (DeLoache & DeMendoza, 1987; Haden, Reese, & Fivush, 1996; Lemish & Rice, 1986; Potter & Haynes, 2000; Reese, Cox, Harte, & McAnally, 2003). Barr et al. found that caregiver questions and labels or descriptions were the most important caregiver verbalization categories in terms of predicting infant looking. Thus, in the present study, these categories were the focus of the analysis. They were defined as follows.

TABLE 1
The Range, Mean, Standard Error, and Standard Deviation for Adult Verbalizations
and Child Behaviors

	<i>Min</i>	<i>Max</i>	<i>M</i>	<i>SE</i>	<i>SD</i>
Adult verbalizations (%)					
Questions	.00	30.00	13.40	.95	10.00
Labels or descriptions	.00	50.00	15.96	1.22	12.76
Child behaviors					
% Looking time	5.33	98.80	66.88	2.15	22.51
Total looking time (sec)	41.30	761.40	508.77	16.33	171.30
Mean look length (sec)	2.39	123.53	16.10	1.51	15.85
Number of looks	6	84	39.28	1.47	15.39
Maximum look (sec)	8	328	78.08	4.98	52.26
Joint measures					
Shared focus	1	5	2.76	.101	1.06
Turn taking	1	5	2.19	.098	1.03

Note. There was one caregiver who said nothing during coviewing (1/110 = .9%).

Questions

Questions were defined as “Wh” questions, questions beginning with what, who, when, or how, such as “Where is the dog?” or “What does a duck say?,” yes-no questions, such as “Do you see the lights?” or “Is that a walrus?,” tag questions, such as “He’s the biggest, isn’t he?,” and directives or requests, such as “Show me the flower.”

Labels or descriptions

Labels were defined as single referents provided for the infant, including animals and colors, such as “Dog” or “That’s green.” Descriptions were defined as utterances longer than single words or labels, such as “The train is going around the track,” or “The seals are going up and down the ramp.”

The total frequencies of each of these categories of verbalizations were calculated across the entire viewing period. Then for each category a proportional measure as a function of the total number of adult verbalizations was calculated. Proportions were used in all analyses because of large individual differences in verbal scaffolding and overall talkativeness during the video presentations (see also Haden et al., 1996). It is important to note that one caregiver made no video-related verbalizations at all. Categories were mutually exclusive and overall reliability for the 6- to 12-month-olds (see also Barr et al., 2008 for similar levels for 12- to 18-month-olds) calculated for 30 of the 110 transcripts was 82% (Cohen’s $\kappa = .80$). Disagreements were

resolved through discussion. Table 1 provides descriptive statistics for the caregiver verbalizations.

Caregiver–infant interactional quality coding scheme

Caregiver–infant interactional quality was coded on the basis of two interactional dimensions, *shared focus* and *turn taking*, adapted from a coding scheme developed by Laible and Song (2006). For each dimension, dyads were rated on a five-point scale (with 1 = low shared focus and no turn taking and 5 = high shared focus and high turn taking). Behaviors were coded in relation to viewing the media, not in regard to toy play.

Shared focus was defined as a sense of togetherness, shared meaning, and unity with regard to viewing the media. High shared focus was defined as consistent and high-quality interaction between the caregiver and infant with regard to the media. In these interactions, the video was the focus of a joint activity (as in book reading or toy play) and there was a strong sense of togetherness and unity between the infant and caregiver. Low shared focus was defined as not sharing instances of focus, attention, or interest.

Turn taking was defined as the degree to which caregivers and infants engaged in conversational exchanges (verbal or nonverbal back-and-forth) with regard to the media. High turn taking was characterized by significant amounts of mutual turn taking directed toward the media, with both infants and caregivers engaging in the exchange. Low turn taking was characterized by the absence of this type of exchange.

Based on 39 of 110 transcripts, reliability was 79% (Cohen's $\kappa = .71$) for 6- to 18-month-olds for shared focus and 82% ($\kappa = .74$) for turn taking. Disagreements were resolved through discussion. Table 1 provides descriptive statistics for the interactional quality measures.

RESULTS

Descriptive statistics

Television exposure

The average television usage per household was 3.48 hr per day ($SD = 2.45$ hr; range = 0–12 hr) based on 93% of the caregivers' reporting. There was no difference in average hours of television usage for children who had prior exposure to *Baby Mozart* ($M = 3.67$ hr, $SD = 2.37$ hr) or had no prior exposure ($M = 3.32$ hr, $SD = 2.54$ hr), $t(100) = -.72$, *ns*, as measured by caregiver report of estimated hours of television usage per day.

Furthermore, only 28% of caregivers reported that they often or almost always talk with their infant during television viewing (see also Mendelsohn et al., 2008).

Video viewing context

As this study was conducted under naturalistic conditions and infants were free to move around their own living rooms during the video presentation, we wanted to report the context in which these videos were being viewed. We coded where the infants were positioned (mostly on the floor, mostly on furniture, both), how much time infants allocated to toy play (low, moderate, and high) and how active they were (low, moderate, and high). Low toy play was coded if the infant did not or rarely played with his/her own toys, whereas high toy play was when infants spent most of their time engaged in play with their own toys and moderate was intermediate between these extremes. Low activity was coded if infants were primarily situated in one location, whereas high activity was coded if infants frequently moved around the room, and moderate activity was intermediate between these extremes. Reliability was 81% ($\kappa = .70$) for all categories based on 22% of the data collected for the 6- to 12-month-olds (see Barr et al., 2008 for 12- to 18-month-old reliability). Approximately half of the infants were on the floor (49%), 38% were on a sofa or a child seat, and the remainder of the infants moved between the floor and sofa (13%). Not surprisingly, activity levels, $\chi^2(4) = 21.02$, $p < .001$, and toy play, $\chi^2(4) = 10.9$, $p < .03$, were lower if infants were seated on the sofa. Although the activity levels of the 9- and 12-month-olds were higher relative to the other age groups, $\chi^2(8) = 15.6$, $p < .05$, there was large variability in the amount of time infants allocated to toy play and their levels of motor activity during the video presentation (see Table 2).

TABLE 2
Toy Play (%) and Activity Level (%) During Coviewing as a Function of Infant Age

<i>Age (months)</i>	<i>Toy play</i>			<i>Activity level</i>		
	<i>Low</i>	<i>Moderate</i>	<i>High</i>	<i>Low</i>	<i>Moderate</i>	<i>High</i>
6	73.91	17.39	8.70	60.87	30.43	8.70
9	50.00	37.50	12.50	33.34	45.83	20.83
12	52.17	39.13	8.70	17.39	60.87	21.74
15	70.00	25.00	5.00	60.00	35.00	5.00
18	57.89	36.85	5.26	47.37	47.37	5.26
Average	60.79	31.17	8.03	43.79	43.90	12.31

Preliminary analyses

Preliminary analyses indicated that gender, sibling status (dummy coded as having siblings or not), socioeconomic status, and household television usage did not significantly enter into any model predicting any of the outcome measures. These variables were therefore collapsed across all subsequent analyses.

Age differences in caregiver verbal input, interactional quality, and looking time

We predicted age-related differences in caregiver verbal input and interactional quality given dramatic changes in linguistic and joint-attentional abilities between 6 and 18 months. We wanted to confirm that our coding schemes were capturing such age-related differences. In order to assess the effects of age on our variables of interest, we conducted a multivariate analysis of variance (MANOVA).

In this analysis, age was the independent variable and looking time, caregiver verbal input, shared focus, and turn taking were the dependent variables. The overall model was significant, $F(16, 105) = 1.97, p = .02$, partial $\eta^2 = .07$. There were main effects of age on each of the variables tested: shared focus, $F(4, 105) = 2.87, p = .03$, partial $\eta^2 = .09$, turn taking, $F(4, 105) = 4.97, p = .001$, partial $\eta^2 = .16$, caregiver verbal input, $F(4, 105) = 4.74, p = .001$, partial $\eta^2 = .15$, and looking time, $F(4, 105) = 2.59, p = .04$, partial $\eta^2 = .09$. Post hoc Student–Newman–Keuls tests ($p < .05$) were conducted to assess these age-related differences. As shown in Table 3, only 9-month-olds differed from other ages on percent looking time, looking significantly less than infants at all other ages. For caregiver verbal input, as expected, verbal input increased from 6 to 18 months. It is

TABLE 3
Mean (SE) Looking Time, Caregiver Verbal Input, Shared Focus, and Turn Taking by
Infant Age

Age (months)	Looking time	Caregiver verbal input	Shared focus	Turn taking
6	63.90 (5.53)a,b	24.30 (3.63)a,b	2.43 (.22)a	1.78 (.13)a
9	58.60 (4.55)a	19.90 (3.08)a	2.54 (.22)a	1.96 (.15)a
12	64.20 (4.60)a,b	29.90 (3.36)a,b,c	2.70 (.19)a,b	2.13 (.18)a
15	72.70 (4.52)a,b	35.30 (4.21)b,c	2.85 (.27)a,b	2.20 (.028)a
18	77.50 (3.58)b	39.60 (4.13)c	3.40 (.18)b	3.00 (.28)b

Note. The values for looking time and caregiver verbal input are percentages. Age groups differ significantly on the four different variables when they are followed by different letters.

important to note that caregiver verbal input was slightly lower for 9-month-olds than for 6-month-olds. We attribute this difference to changes in activity patterns between 6 and 9 months (see Table 3). As expected, both shared focus and turn taking increased systematically from 6 to 18 months. The 18-month-olds and their caregivers engaged in significantly more turn taking than the 6- to 15-month-olds and the 18-month-olds were significantly higher than the 6- and 9-month-olds on shared focus. The 6-month-olds maintained levels of looking that did not differ significantly from any of the older age groups. Nevertheless, this group received significantly lower levels of caregiver verbal input, shared focus, and turn taking when compared with 18-month-olds.

Next, we assessed whether looking time, shared focus, turn taking, and caregiver verbal input correlated with one another as a function of age. We conducted bivariate correlations between these four variables of interest. Once again, as expected, shared focus, turn taking, and caregiver verbal input moderately correlated with each other across age but, unlike their older counterparts, 6-month-olds exhibited no correlations between looking time and any other variable of interest (see Table 4). This lack of

TABLE 4
Correlations Between Shared Focus, Turn Taking, Caregiver Verbal Input, and Infant Looking Time as a Function of Age

	<i>Shared focus</i>	<i>Turn taking</i>	<i>Caregiver verbal input</i>
6-month-olds			
Turn taking	.597**	—	
Caregiver verbal input	.695**	.675**	—
Looking time	.163	.017	.341
9-month-olds			
Turn taking	.738**	—	
Caregiver verbal input	.502*	.161	—
Looking time	.501*	.049	.438*
12-month-olds			
Turn taking	.729**	—	
Caregiver verbal input	.323	.516*	—
Looking time	.443*	.345 [†]	.492*
15-month-olds			
Turn taking	.852**	—	
Caregiver verbal input	.473*	.443 [†]	—
Looking time	.219	.103	.499*
18-month-olds			
Turn taking	.868**	—	
Caregiver verbal input	.437 [†]	.539*	—
Looking time	.400 [†]	.306	.590**

Note. [†] $p < .10$, * $p < .05$, ** $p < .01$.

correlations raises interesting questions regarding predictors of looking time across infancy.

There are three main points to take from this examination of age-related changes. First, the pattern of results suggests that we have a good proxy for interactional quality during media viewing that is sensitive to age-related changes in patterns of interaction. Second, from these measures it appears that there is individual variation in how parents and infants coview from 6 to 18 months. Third, the age-related changes present an interesting pattern with regard to how to interpret looking patterns when infant levels of activity and relations between interactional quality and infant looking are considered. That is, our findings suggest that looking patterns at 6 months are less likely to be influenced by parental factors than are the looking patterns of older infants. In addition, changes in infant locomotion between 9 and 12 months may change how much caregiver verbal input infants receive, even though joint-attentional abilities are increasing. Finally, overall significant increases in shared focus, turn taking, and caregiver verbal input during television viewing occur between 15 and 18 months of age. Our final goal was to examine whether or not individual differences in interactional quality would explain additional variance in looking time when caregiver verbal input, prior exposure to content, and age were accounted for.

Predictors of infant looking and the role of interactional quality

To address the question of whether interactional quality is associated with infant looking beyond the roles of age, prior exposure, and caregiver verbal input, we conducted a hierarchical regression analysis. The dependent variable was the percentage of the presentation that the infant looked toward the media. The independent variables in block one were age, caregiver verbal input, and whether or not the infant had prior exposure to the program. In block two, the measures of interactional quality, shared focus, and turn taking were entered to assess their added contribution to the variance accounted for by the model. The interactional quality variables, shared focus and turn taking, predicted an additional 4.9% of the variation (F change = 3.90, $p = .02$, effect size $f^2 = .08$). The results of the final regression model are presented in Table 5.

DISCUSSION

Taken together, the findings from this study partially replicate and extend the findings of Barr et al. (2008). There is a gradual change in the mediation of television viewing from 6 to 18 months, with increased levels of caregiver

TABLE 5
Final Regression Model for Variables Predicting Infant Percent Looking Time

<i>Predictors</i>	<i>Unstandardized coefficients</i>		<i>Standardized coefficients</i>	
	<i>B</i>	<i>SE</i>	β	<i>t</i>
Age	.005	.005	.086	.99
Prior exposure	.091	.036	.202	2.50*
Caregiver verbal input	.552	.120	.448	4.58**
Shared focus	.076	.027	.355	2.77**
Turn taking	-.059	.028	-.269	-2.09*

Note. * $p < .05$, ** $p < .01$.

verbal input and interactional quality as a function of age. Furthermore, hierarchical regression showed that interactional quality explains additional variance in infant looking time, even when caregiver verbal input, age, and prior exposure to content are considered. Although age was not a significant predictor of infant looking in the regression model, analyses suggested that there were age-related changes in all variables of interest. Based on this analysis of age-related changes, it seems that the predictors of looking to media may change across infancy.

Infant media-directed looking

Across the age range from 6 to 18 months, looking time does not increase substantially, despite rising levels of interactional quality and caregiver verbal input during the second year of life. In fact, we found high levels of infant media-directed looking across the age groups. With this in mind, it is important to address what the measure of looking time actually means in terms of attention and processing.

Looking time is sometimes considered a measure of endogenous attention (Kannass & Colombo, 2007), and higher looking time may reflect higher overall levels of processing (for a review, see Richards & Anderson, 2004). By 6 months, infants can already process televised content to some degree; they can imitate simple actions from television (Barr, Muentener, & Garcia, 2007) and can parse goal-directed actions (Hofer, Hauf, & Aschersleben, 2007). On the other hand, Aslin (2007) proposed that it is inaccurate to equate looking with visual attention. Aslin suggests that attention can vary in intensity during looking. In addition, attention may be allocated to a different spatial location from gaze. Thus, the measure of percent looking time may not fully inform us about infants' attention to, or processing of, television content (for further discussion, see Richards & Anderson, 2004).

This distinction between looking, attention, and processing is further underscored by research into comprehensibility, which shows gradual developmental change across infancy. Eighteen- and 24-month-olds differentiate between comprehensible and incomprehensible sequences; they engage in more sustained looking to comprehensible sequences (Richards & Cronise, 2000) and also look significantly less to distorted sequences in programs designed for infants (*Teletubbies*) than the correctly sequenced program (Anderson & Pempek, 2005). This suggests that they are processing the content to some degree. By contrast, 6- and 12-month-old infants allocate equal attention to comprehensible and incomprehensible programs, implying that looking may not indicate comprehension in younger infants. It is important to note that age-related differences in looking that have been observed in these studies have occurred in the absence of parent scaffolding behaviors. These age-related differences may emerge because they more directly reflect differing levels of comprehension. Clearly, future research on infant attention to videos is called for that compares looking with and without parent responsiveness.

When considering this ambiguity from a developmental perspective, it seems that the high looking times of younger infants might be driven by different factors than those of older infants. High levels of looking in 6-month-olds in the absence of correlated levels of informative caregiver verbal input and interactional quality suggest that the predictors of infant looking in this age group may not yet be verbal or social, but rather may be a function of the high perceptual salience of the program content (Calvert, 2006). By contrast, the increasing levels of caregiver verbal input and caregiver–infant interactional quality in the 15- and 18-month-old groups suggest the growing importance of social engagement. The negative association between turn taking and looking time may reflect the fact that as infants get older and engage in more turn taking, they will necessarily turn away more from the television. That is, while looking time is a good proxy for engagement with the television content, increasing social mediation may counterintuitively decrease looking time. Together, these findings suggest that the predictors of looking time may differ to some degree across infancy.

There are a number of reasons to think this might be the case. First, robust triadic interaction does not emerge until approximately 12 months of age (for a review, see Butterworth, 2001). At 18 months infant's ability to attend to objects that are behind him or her increases dramatically, allowing for more effective shifts in orientation between the television and the caregiver. The typical television viewing configuration (caregiver behind infant adopted by over half our sample) makes strong triadic interaction during covieing more challenging, leading to less possible interaction for younger infants. Second, a substantial increase in productive vocabulary and the

initial stages of syntactic development typically begin around 18 months of age, which is likely to affect the social coviewing context for older infants (Krcmar, Grela, & Lin, 2007). Finally, the development of crawling and walking late in the first year of life may change the way infants relate to television viewing. This may also provide an explanation for the reduced looking in 9-month-olds when compared with other groups (for a review, see Campos et al., 2000). Thus, rapid developmental changes between 6 and 18 months may contribute to the increasing association of social factors with infant viewing behavior across infancy.

The role of social interaction in infant media-directed looking

The present findings suggest that parents have an important role to play in mediating their infant's television viewing, particularly as infants get older. Building on the familiarity preference associated with prior exposure (e.g., Richards & Gibson, 1997) and looking time to perceptually salient formal features, such as sound effects (Calvert, 2006), caregivers are able to direct infants to the highly salient area of space occupied by the television and maintain high looking time over a relatively extended period. As infants get older and their verbal comprehension levels increase, caregiver verbal input may enhance the infant's ability to process televised content over the course of a program. This in turn may lead to better comprehension of program content.

Huston and Wright (1983), in their sampling model of attention, predicted that with repeated exposures to specific content, children would begin to acquire knowledge about the formal features of the program and that the knowledge of formal features would allow them to determine when to attend to central content. It is likely that discrimination of key aspects of content are also learned in the context of mediated social viewing. Over time, toddlers learn which key points to attend to during programming and when to disengage for social interaction. The benefit of such social interaction during coviewing may outweigh the benefit of more looking time. As such, looking patterns may change substantially across the infancy period, without dramatic changes in overall percent looking time.

This is noteworthy with respect to the broader influence of social interaction on cognitive development. In toddlers and preschoolers, the discourse style and emotional warmth of the caregiver predicts vocabulary and socio-emotional development (e.g., Bruner, 1983; Laible & Song, 2006). Laible and Song (2006), for example, found that the amount of maternal elaboration, defined as the provision of descriptions and open-ended questions, during storybook reading, was related to performance on measures of socio-emotional development in preschool children. From the present study, it appears that these interactive caregiver strategies are employed during

television viewing early in development and that these are associated with infant looking even before the first words.

Consistent with social mediation theory, some joint frame of reference is present during coviewing from relatively early in infancy. As predictors of infant looking, the contributions of caregiver verbal input and caregiver–infant interactional quality seem to be as important as that of prior exposure to the content, beginning around 9 months of age. This finding is consistent with social learning research which suggests the significance of joint interaction for knowledge acquisition (Carpenter, Nagell, & Tomasello, 1998; Csibra & Gergely, 2007; Kuhl, 2007). Indeed, it seems as though caregiver verbal input may contribute more than program content to any early learning occurring during or resulting from coviewing, given the recent research suggesting limited learning from television in infancy (DeLoache et al., 2008; Kuhl, 2007; Robb et al., 2009). If, for example, infants under the age of about 20 months are not able to learn vocabulary from television, as Krcmar et al. (2007) suggest, then the caregiver's contribution during coviewing is especially important for young infants. It is important to note that in prior studies researchers have assessed infant learning from television either in the absence of caregiver interaction (Krcmar et al., 2007), or in the absence of measures of caregiver–infant interaction (DeLoache et al., 2008; Robb et al., 2009). Individual differences in dyadic caregiver–infant interactions have not been accounted for in such research. Thus, researchers may have underestimated the amount that infants were able to gain from televised presentations. One additional clarification is that interactional quality captures the bidirectional nature of the interaction between the infant and his/her caregiver. That is, although we predict infant looking time from caregiver and interactional quality variables, it is important to consider that caregivers may be responding to the infants' interest in the programming content. That is, the causal direction could possibly be from the infants' interest to the mothers' behaviors rather than the reverse.

CONCLUSION

Caregiver–infant interactional quality is linked to infant looking behavior during the first 2 years of life, beyond the role played by caregiver verbal input and prior exposure to the program. From previous research it is clear that television use in infancy is increasing (Anderson & Pempek, 2005; Rideout & Hamel, 2006; Zimmerman et al., 2007b), that children have a limited ability to learn from television in this age range (e.g., Krcmar et al., 2007; Kuhl et al., 2003; Zimmerman et al., 2007a), and that live input is essential for developing vocabulary and language abilities (Kuhl, 2007;

Sachs, Bard, & Johnson, 1981). Taken together, these results suggest that caregiver verbal input and interactional quality is critical during coviewing, particularly from 9 months onward. This may be an important factor to consider with regard to recent research into the effects of television exposure on infants and reports of limited amounts of active parental coviewing (for a review, see Anderson & Pempek, 2005; Christakis, 2009; Courage & Setliff, 2009; Mendelsohn et al., 2008). Practically speaking, it may be even more important for caregivers to scaffold television viewing for infants younger than 2 years of age than at any other time in their development.

ACKNOWLEDGMENTS

We thank the families for their participation and Don Nathanson, Brenda Lucatera, and Anastasia Stepnova for their help in data collection. This research was funded by an NSF grant to Children's Digital Media Center (#NSF 0126014) and the Georgetown University Graduate School of Arts and Sciences funding to Ashley Fidler and Elizabeth Zack.

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