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The Effects of Background Television on the Toy Play Behavior of Very Young Children

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This experiment tests the hypothesis that background, adult television is a disruptive influence on very young children's behavior. Fifty 12-, 24-, and 36-month-olds played with a variety of toys for 1 hr. For half of the hour, a game show played in the background on a monaural TV set. During the other half hour, the TV was off. The children looked at the TV for only a few seconds at a time and less than once per minute. Nevertheless, background TV significantly reduced toy play episode length as well as focused attention during play. Thus, background television disrupts very young children's play behavior even when they pay little overt attention to it. These findings have implications for subsequent cognitive development.

Consider a 2-year-old child playing with toys in the living room. The television is playing a program designed for adult viewers. Mother is in the kitchen making dinner while listening to the TV. The child intermittently looks at the television for brief periods of time. Is television having an effect on the child? In this article, we test the hypothesis that background television is a disruptive influence on very young children's behavior, specifically object play.

Prior research indicates that young children pay little attention to television that they cannot comprehend (e.g., Anderson, Lorch, Field, & Sanders, 1981) and little attention to adult TV programs in general (Schmitt, Anderson, & Collins, 1999). Thus, an adult television program is essentially in the background as the child plays with toys or engages in social interactions. Here, we adopt the term *background television* to refer to adult content that is largely incomprehensible to a very young child and to which they ordinarily pay little cumulative attention (see Anderson & Evans, 2001). Nevertheless, as a dynamically varying audiovisual distraction, background television may interfere with the ability of very young children to sustain an activity in a focused and organized manner.

The American Academy of Pediatrics, Committee on Public Education (1999) recommends no screen media exposure for children aged 2 years and younger. Nevertheless, nearly 75% of parents of very young children say that television is on "about half of the time" or more, even if no one is watching (Rideout & Hamel, 2006; Rideout, Vandewater, & Wartella, 2003). There is substantial opportunity in these homes for background television to have a chronic disruptive impact on very young children's behavior.

It should be emphasized that the present study is concerned with the impact of adult programming that is in the background from the perspective of the child. Very young children certainly spend time watching programs made for them. Studies that did not specifically assess background TV have found that very young children watch from 1 to 3 hr a day, on average (Anderson, Lorch, Collins, Field, & Nathan, 1986; Carew, 1980; Clarke-Stewart, 1973; Gottfried, 1984; Lemish, 1987; Rideout & Hamel, 2006; Rideout et al., 2003; Zimmerman, Christakis, & Meltzoff, 2007), although there are large percentages of children whose parents claim they do not watch any TV (Certain & Kahn, 2002; Christakis, Zimmerman, DiGiuseppe, & McCarty, 2004; Rideout et al., 2003; Woodard, 2000).

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In the only study to specifically consider background TV, Pierroutsakos, Hanna, Self, Lewis, and Brewer (2004) asked 100 upper-middle-class parents to keep diaries of their 2.5- to 24-month-old infants' TV exposure. The children were exposed to an average of 120 min of TV each day; 49% of that exposure was to adult and preteen programming. It is likely that a broad survey would reveal that a large percentage of very young children are exposed to much more background TV than found by Pierroutsakos et al. insofar as in-home automated monitoring of TV use by Nielsen Media Research indicates that the average American home has a TV set in use more than 8 hr a day (Gertner, 2005).

Effects of Television on Very Young Children

There is very little experimental research on the effects of television on infants and toddlers and no direct research on the effects of background exposure. The studies that have examined long-term effects of early television exposure are correlational and do not account for content of the programs, thus combining exposure to age-appropriate and background television. Television exposure for children aged 30 months and younger is associated with poorer cognitive and language development (Carew, 1980; Gottfried, 1984; Nelson, 1973; Wachs, 1985; Wachs & Gandour, 1983; Wachs & Gruen, 1982; Zimmerman & Christakis, 2005). One study reported that language development depended on which child-directed programs were regularly watched, with some programs positively associated with language development and other programs negatively associated (Linebarger & Walker, 2005).

Christakis et al. (2004) reanalyzed data from the 1980s National Longitudinal Survey of Youth to determine if there was a relationship between early TV viewing and later attention disorders. Parents' estimates of their children's TV viewing at 18 and 42 months were positively associated with parental reports of attention disorder symptoms at age 7 after a variety of covariates were statistically controlled. An analogous study in Denmark, however, failed to find a significant relationship, although the trend was in the same direction (Obel et al., 2004). Television viewing by older preschoolers does not predict attention disorder symptoms (Stevens & Mulsow, 2006).

Several studies have revealed that the level of ambient background noise in the home and household chaos are negatively related to cognitive development in the first 5 years of life (Gottfried, 1984; Wachs, 1985, 1986; Wachs & Gandour, 1983). Because television is a major contributor to the level of ambient noise in these studies, it may play a disruptive role, as hypothesized. Nevertheless, the studies cited above that found negative outcomes associated with television exposure do not allow causal relationships with television to be conclusively inferred.

Background Television and Toy Play

Based on videotapes of family TV viewing recorded in homes, Schmitt, Woolf, and Anderson (2003) reported that 2-year-olds played with toys 32% of their time spent with television. The present study, by experimentally manipulating the presence of background television, is designed to determine whether television is a proximal disruptive influence on the organization of very young children's behavior, specifically toy play. Television may have such an influence by initiating repeated orienting reactions to the visual and auditory changes that frequently occur on commercial television. Television may also be viewed as competing for cognitive resources necessary to instantiate and execute play schemes (cf. Armstrong & Greenberg, 1990). In addition, as a source of environmental noise, background television may have a general disruptive effect that has been observed on children in noisy environments (Hygge, Evans, & Bullinger, 2002; Wachs, 1986).

Virtually every theory of child development hypothesizes that play is related to healthy cognitive and social development (e.g., Piaget, 1962). During play, children refine motor skills, explore the physical properties of objects, learn principles of cause and effect, and engage in means–ends problem solving (Power, 2000). Pretend play, in particular, helps children develop representational abilities as well as experiment with social roles (Bretherton, 1984; Power, 2000). If background television disrupts young children's play, chronic exposure to background television may at least partially be a cause of the negative relationship between early exposure to television and cognitive development.

In this research, we examine play maturity, play episode length, and focused attention during play. With respect to play maturity, we use a scale based on research by Belsky and Most (1981). The logic of the scale extends from numerous studies that reveal a developmental sequence of toy play behaviors. As development proceeds from early infancy, visually guided manipulation and object-appropriate behaviors increase and become more symbolic and complex (Belsky & Most, 1981; McCall, 1974).

Play episode length refers to the time that elapses from the point at which the child comes into contact

with a toy until the child ceases active play with that toy (Choi & Anderson, 1991). As children mature, play episode length increases (Malone, 1997; Ruff & Lawson, 1990), probably reflecting more sequentially complex play schemes as well as an ability to sustain attention. Short play episode length is a predictor of attention deficit disorders and other developmental problems (e.g., Faden & Graubard, 2000; Handen, McAuliffe, Janosky, Feldman, & Breaux, 1998; Malone, 1997).

The intensity of attentional engagement may vary during play episodes. The term *focused attention* has been used to designate activity during which ''attention is directed more or less exclusively to one target or task and not divided or shared between targets or tasks'' (Ruff & Rothbart, 1996, p. 111). As motivation and attention are linked (Derryberry & Tucker, 1990), focused attention usually results when a target activity is highly motivating and is made possible by inhibiting responses to all but the object or task (Ruff, Capozzoli, & Saltarelli, 1996).

Infants and toddlers are capable of focused attention, although the underlying processes supporting attention change substantially during the first 3 years. Ruff and Rothbart (1996) describe the development of two different attentional systems in very young children. The orienting/investigative system, dominant for the 1st year of life, is primarily responsive to novelty, meaning attention in young infants is governed by the salient perceptual features of environmental stimuli. Ruff, Saltarelli, Capozzoli, and Dubiner (1992) found that focused attention in 5- to 12-month-old infants was greatest for novel objects. After 2–3 min of exposure to the same object, however, episodes of focused attention were terminated. Focused attention episodes in infancy are thus usually short, occurring intermittently with other exploratory actions (e.g., banging or mouthing).

The second system of attention, that of higher level control, appears at the end of the 1st year as the prefrontal cortex matures. Ruff and Rothbart (1996) hypothesize that the second system facilitates or inhibits the orienting/investigative system as children develop the cognitive ability to formulate plans or goals. These plans can prevent habituation by facilitating sustained attention after objects are no longer novel. As children develop cognitively and acquire language, their goals can become more sophisticated leading to longer episodes of focused attention, particularly during play. Consistent with this theory, focused attention during play increases with age (Ruff & Capozzoli, 2003; Ruff & Lawson, 1990). With respect to the present research, because very young children have poorly developed higher level control, it is expected that they have a poor ability to filter irrelevant stimuli as they engage in object play.

In light of research on attention development, background TV should disrupt sustained and focused attention during play. This hypothesized disruption occurs because TV repeatedly elicits orienting responses (ORs), thereby drawing attention away from the play. Physiologically, the OR is characterized by heart rate decrease, dilation of blood vessels that lead to the brain, and constriction of blood vessels that lead to the major muscle groups, along with visual orientation in the direction of the stimulation that elicited the OR. The cardiovascular changes are generally thought to reflect shifts in blood supply to the brain in service of alert investigation of novel stimuli. Consistent with previous OR research, Reeves, Thorson, and Schleuder (1986) found decreases in alpha waves that were time locked to formal features (e.g., cuts, sudden camera changes, movement, sound effects) on electroencephalographic (EEG) recordings of adults watching television. Richards and his colleagues (Richards & Casey, 1992; Richards & Cronise, 2000; Richards & Gibson, 1997) also found evidence of the OR produced by television in studies of heart rate in infants and toddlers.

A child who orients to a TV screen may suspend play in order to attend to television. Because there is a visual or auditory change on TV approximately every 6 s (Schmitt et al., 1999), background television could disrupt children's play many times over the course of a play session. A few studies suggest that brief interruptions can terminate young children's ongoing activities. DiLalla and Watson (1988) observed 2.5- to 6.5-year-old children's reactions to three experimenter-initiated interruptions to an ongoing fantasy play sequence. Older children were better able to respond to interruptions without disrupting their subsequent play. The 3-year-olds were unable, however, to return to the play episode without experimenter prompts. Furthermore, if the play resumed, it was less intense. To the extent that it has a disruptive influence, background television may prevent young children from returning to play at the same level of cognitive sophistication, if at all.

It is possible that television does not have these disruptive effects insofar as Ruff and Capozzoli (2003) found that an intermittent brief distractor did not reduce focused attention during toy play in very young children. This may have happened because the children became progressively less distractible over the 12-min course of the play session, suggesting that they habituated to the distractor. However, television, as a complex, continuously varying

distractor, may have more substantial effects and may prove to be resistant to habituation.

In the present research, 12-, 24-, and 36-month-old children were observed playing with toys for 1 hr. Children in this age range are just beginning complex and symbolic play and have poorly developed control over focused and sustained attention (Ruff & Rothbart, 1996). For half the time, a TV set played the television program *Jeopardy!* with commercials; for the other half, the TV set was off. The children were videotaped, and observers subsequently coded the tapes for looking at television, length of play episodes, length of focused attention during play episodes, and maturity of play. We hypothesized that background television would disrupt the children's toy play, shortening the length of play episodes and reducing the percent of play that was focused. We also hypothesized that background television would reduce the maturity of children's play.

Unlike prior research on television's impact, we focused specifically on background TV insofar as *Jeopardy!*, a game show directed at adults, should be nearly incomprehensible to such young children. Because many children are exposed to background television in the home and some studies suggest such exposure may negatively influence cognitive and language development, this study is a first step toward understanding one mechanism by which television may affect development.

Method

Participants

Fifty children (1 Black, 2 Hispanic, and the remainder White), 17 (9 girls) 12-month-olds, 16 (8 girls) 24-month-olds, and 17 (9 girls) 36-month-olds, were randomly assigned to either the ''TV first'' or the ''TV second'' order with the constraint that half were assigned to each. All children were within 1 month of their first, second, or third birthdays. Seventy-eight percent of children had a participating caregiver whose educational level could be classified as ''some college'' or higher, with 60% having completed college and 12% having attained a graduate degree.

In general, these ages (12, 24, or 36 months) were chosen because a minimal amount of research has been conducted on the impact of television on very young children. More specifically, the 36-month-old group was chosen because this age overlaps with the youngest ages used in some previous work on children and television. The two younger groups were chosen because they were young enough to ensure that the program used in this study would, in fact, be background television for them insofar as children pay little attention to content that they do not understand (Anderson et al., 1981).

Potential participants were identified through state birth records. Children were recruited by means of a letter describing the study to parents and a follow-up telephone call requesting participation. The only selection criterion was that children had no parent-identified visual or hearing impairments. No participants were excluded based on this criterion.

Materials and Setting

Two rooms were used: a playroom (4.27 $\times$ 3.81 m) and an adjoining observation room separated by a one-way mirror. The playroom was furnished with an armchair, end table, toy chest, small rug, floor pillow, credenza, VCR, and 53.30-cm (21 in., diagonally measured) television set. The toy chest was open shelved and held a variety of age-appropriate toys representative of a standard toy set (e.g., McCune-Nicholich & Fenson, 1984). Pilot research indicated that no one toy in the set was overwhelmingly popular. A variety of current magazines and a newspaper were placed on the end table within reach of the armchair.

During the television session, the VCR played an episode of *Jeopardy!*, a TV game show produced for adult audiences, including the commercials that appeared with the show at the time of airing. The experimenter could control the TV and VCR from the observation room using remote control devices. At the position most frequently occupied by children as they played with toys, the TV screen subtended a visual angle of 17° horizontally. At that position, the audio volume (preset by the experimenter) at head level of a typical 2-year-old child averaged 57dB (C weighting over ten 200-ms samples), about the level of typical human speech.

Two digital video (DV) cameras were used to record the child's behavior. One DV camera, located in the playroom, was hidden in a shoebox covered with black cloth on the floor under the credenza. The other DV camera was mounted on a tripod in the observation room. The two cameras were connected to a DV mini-cassette recorder in the observation room via a switcher. Two separate monitors were also attached to the switcher allowing the experimenter to simultaneously view the perspectives of both cameras. The experimenter could thus choose at any moment which camera captured the best image of the child. An omnidirectional microphone connected to the VCR hung from the ceiling in the playroom.

Procedure

Upon entering the playroom, the children were allowed to become familiar with the toys while the experimenter explained the procedure to the parents. Once written informed consent was obtained, the experimenter left the playroom for the remainder of the session. From the observation room, the experimenter immediately began videotaping the child in the playroom. In the TV first order, the experimenter remotely started the television program as soon as video recording had commenced. When the program ended, after approximately 30 min, the experimenter turned off the television from the observation room and continued to videotape for an additional 30 min without background TV. In the TV second order, the TV remained off for the first 30 min after which the experimenter turned on the TV and VCR with the remote control.

The focus of the present experiment was on background television's influence on children's solitary play. Consequently, parents were asked not to initiate play with their child or to actively encourage their child to play with any particular toy. The experimenter suggested the parents watch TV or read magazines unless their children became fussy or explicitly demanded their attention. The parents were also asked to fill out a questionnaire about their children's media use. The children were free to play with the toys or watch TV for the duration of the hour.

Coding

Videotapes were coded with a computer using the tape-logging utility of the video-editing program, Adobe Premiere. A research assistant watching the videotape, having identified the onset of a specified behavior according to a detailed set of coding instructions, pressed an appropriate key. The computer stored the identity and the video frame number of the event. The research assistant then advanced the tape at any desired speed until the behavior was judged to have ended and pressed an appropriate key. The frame number of the end point was thus stored. In this manner, the temporal onsets and offsets of the behavior stream were recorded.

Coding proceeded in four passes. The first pass recorded the onsets and offsets of children's looks at the television screen. A look began when a child's eyes oriented to the screen and ended when the child looked away (for details, see Anderson & Levin, 1976).

The second pass recorded the onsets and offsets of play episodes. The coding used a procedure developed by Choi and Anderson (1991). An onset was defined as the frame in which a child touches a toy with which the child subsequently plays. An offset is the frame where a child stops actively playing with the toy, even if passive contact is maintained. Simultaneous contact with more than one toy constituted a single play episode if the toys were combined in any way (e.g., banging them together or using several objects in a pretend play sequence such as cooking). In cases where a play episode was interrupted by a look at the TV (when the TV was on), a play episode was coded as ending only if the look lasted longer than 3 s or, if the look was shorter than 3 s, the child did not return to the same toy.

The third pass recorded the onsets and offsets of focused attention during object play for each play episode. Coders were trained to recognize the behavioral characteristics associated with focused attention as described by Ruff and Rothbart (1996). These behaviors included a serious facial expression with furrowed brow, a forward leaning posture toward the object, and minimized extraneous body movements. A similar 3-s rule was employed in that brief looks away from the toy were not coded as ending focused attention provided that the child looked away for less than 3 s and returned to a state of focused attention with the same object.

A fourth pass coded maturity of play using the 12-point scale published by Belsky and Most (1981). This scale was supplemented by two additional levels adapted from an unpublished scale by McCune-Nicholich (1980) to encompass play by somewhat older children (36-month-olds) than had been observed by Belsky and Most. A numerical value was assigned to each level of play. Levels 1 through 12 were exactly as described by Belsky and Most, and Levels 13 and 14 were those added for the purpose of the current study. For instance, ''mouthing'' or ''simple manipulation'' (touching a toy), according to the scale by Belsky and Most, received a 1 or 2, respectively. An episode of ''functional-relational'' play, in which the child combined two objects in a meaningful way (e.g., touching a spoon to a plate), received a 5. A self-directed symbolic play episode received a 7, whereas a play episode involving ''substitution'' (e.g., the child put a block up to a doll's mouth as though it were a bottle while talking about feeding the doll) received a higher score of 9. Level 13 was used to indicate object agency with descriptive and functional language. Thus, this level designated times in which the child played the role of a doll within a pretend play scheme (e.g., the child attributed dialogue to a plastic Fisher-Price doll). Last, object play in which the child incorporated imaginary objects for which there was no concrete referent received a code of 14.

Play maturity was coded continuously from the beginning to the end of each previously identified play episode. If the maturity of play changed within a play episode, as it often did, coding encompassed that change.

A videotape of a typical child at each age was used for training. A research assistant worked with the training tape until he or she achieved acceptable reliability with an experienced coder (phi correlation greater than .70). At this point, the assistant was asked to code a test tape. The assistant was allowed to code tapes from the study only if he or she attained a high correlation with the supervisor's test tape coding for both the onsets and the offsets of the target behavior.

To assess interobserver reliability (IOR), two independent observers scored 4 participants at each age (12 in all) for each measure. These IOR tapes were distributed throughout the entire coding period to monitor reliability over the course of the study. Agreement was acceptably high for all behaviors. Intraclass correlations were .85 for mean play length, .69 for mean length of focused attention, and .98 for mean level of play maturity weighted by the time spent at each level. Although 12 tapes were double-coded for looks and deemed acceptably high, due to experimenter error, there is only a record of 4 of those double-coded tapes. The phi correlations (a measure of temporal overlap calculated for each pair of observers) for these tapes were all above .90.

Results

The initial analyses for the play measures were 3 (age: 12, 24, and 36 months) $\times$ 2 (sex: male and female) $\times$ 2 (test order: TV first and TV second) $\times$ 2 (condition: TV and no TV) analyses of variance (ANOVAs) with condition as a repeated measure. Dependent measures were percent of session spent in play, mean play episode length, percent of play that was focused, mean length of focused play, and average maturity of play weighted by time spent at each level. An additional between-subjects ANOVA (excluding the condition variable) was run to analyze the total number of looks at the television when it was on.

The ANOVAs revealed order effects for play episodes, focused attention, and the total number of looks at the television. Investigation of these effects indicated that there were systematic curvilinear changes in these measures over time. Therefore, hierarchical linear modeling (HLM) was used to systematically analyze change over time and to isolate the effects of TV and other factors. HLM is a particularly powerful statistical tool for investigating measures that are differentially expressed over time and can simultaneously assess continuous within- and between-subjects factors without overestimating power (for more details on this method, see Raudenbush & Bryk, 2002). Outcome variables for the HLM analyses were measured in 6-min intervals to account for changes over time. For play episodes and focused attention, one set of HLM analyses assessed the effect of TV condition. A second set of analyses assessed the particular influence of looks at the TV screen on play measures during the TV condition. These tests are described in detail within each section below. Because no order effects were found for play maturity, only the simpler results from ANOVA are presented here.

Bivariate correlations between all dependent variables are presented in Table 1. Descriptive statistics for all the dependent measures are presented in Table 2, but the reader should note that these are unadjusted means and as such do not control for variability with time or other factors accounted for in the HLM analyses. A brief description of how to interpret the HLM results can be found in the Appendix. All reported results are significant at alpha level $p < .05$ or better.

Number of Looks at Television

The HLM analysis for number of looks at the TV included linear and quadratic change over time (measured in 6-min intervals) as Level 1 (within-subjects)

Table 1
Bivariate Correlations Between Dependent Variables

	Play percent	Play length	Focused percent	Focused length	Play maturity
Play percent	1.00	.62**	.29*	.47**	.47**
Play length	.62**	1.00	.37**	.63**	.63**
Focused percent	.29*	.37**	1.00	.71**	.38**
Focused length	.47**	.63**	.71**	1.00	.56**
Play maturity	.47**	.63**	.38**	.56**	1.00

*$p < .05$. **$p < .01$.

Table 2
Means (SEs) for All Dependent Measures as a Function of Age and Condition

	Looking at television			Play episodes		Focused attention		Maturity
	Percent	Number	Length	Percent	Length	Percent	Length	Weighted average
12 months								
TV	5.51 (1.32)	26.55 (2.98)	3.09 (0.31)	65.70 (5.02)	42.57 (7.73)	21.08 (3.84)	12.72 (1.73)	2.65 (0.13)
No TV	—	—	—	71.11 (4.46)	50.65 (6.85)	29.85 (4.97)	17.58 (1.88)	2.60 (0.09)
24 months								
TV	6.15 (1.12)	26.13 (3.06)	3.83 (0.43)	70.82 (3.53)	73.69 (14.14)	36.80 (4.50)	22.29 (2.14)	4.86 (0.35)
No TV	—	—	—	75.37 (3.58)	74.51 (9.79)	31.77 (5.17)	20.60 (3.03)	4.86 (0.41)
36 months								
TV	3.06 (0.68)	16.55 (2.98)	2.93 (0.36)	75.80 (3.35)	72.72 (7.04)	43.59 (5.29)	31.80 (5.00)	5.02 (0.34)
No TV	—	—	—	79.76 (3.13)	106.68 (13.61)	44.81 (5.81)	33.78 (4.32)	5.52 (0.32)
Average								
TV	4.88 (0.64)	23.08 (1.74)	3.27 (0.21)	70.77 (2.37)	62.78 (6.00)	33.44 (2.92)	22.27 (2.19)	4.16 (0.23)
No TV	—	—	—	75.42 (2.19)	77.33 (6.79)	35.55 (3.17)	24.06 (2.10)	4.31 (0.25)

Note. Dependent measures are looking at television (percent of TV condition spent looking at screen, number of looks at TV, and length of looks), play episodes (percent of session spent in play and length of episodes), focused attention (percent of play that was focused and length of focused attention episodes), and play maturity (average maturity of play weighted by time spent at each level). All lengths are measured in seconds. For maturity of play, numbers denote qualitative level of play.

predictors and child age, sex, and order of conditions as Level 2 (between-subjects) predictors. Looks at the TV were quite short, and visual attention averaged about 5% indicating that television was truly in the background for these children (see Table 2). HLM analyses revealed that the overall number of looks at the TV was greater when the TV condition was presented in the second half hour, producing a significant effect of order, $B = -48.09$ ($SE = 9.65$), $t(47) = -4.98$. The number of looks at the TV generally decreased over time that the TV was on, particularly from the first 6-min interval to the second as indicated by a significant positive quadratic slope, $B = -12.27$ ($SE = 2.59$), $t(48) = -4.73$, $p < .001$, and $B = 0.70$ ($SE = 0.15$), $t(49) = 4.57$, $p < .001$, for linear and quadratic slopes, respectively. The increase in looks at the screen when TV was presented in the second half hour was largely due to more looks in the first 6-min interval that the TV was on, as indicated by a significant effect of order on the time slope, $B = 7.86$ ($SE = 1.69$), $t(48) = 4.66$. Furthermore, looks diminished with age, primarily because 3-year-olds had fewer looks at the TV than the two younger groups (see Table 2; Figure 1), $B = -1.05$ ($SE = 0.28$), $t(47) = -3.73$. Sex was not a significant predictor of the number of looks. The decline in look number from the first 6-min interval to the second suggests that children habituated attention to the TV somewhat during the first 6 min but that there was no further habituation.

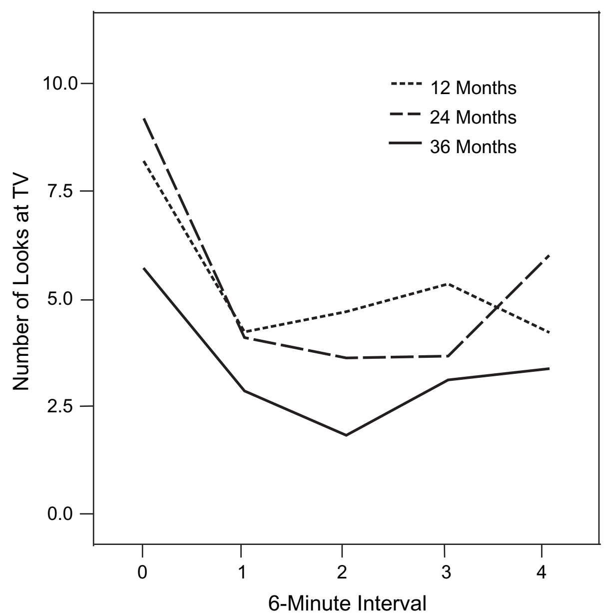

Figure 1. Mean number of looks at TV per 6-min interval as a function of age (values are unadjusted by hierarchical linear modeling coefficients).

Importantly, analyses of the effects of TV on play that excluded data from the first 6-min interval did not affect conclusions resulting from analyses of all the data. That is, the initial novelty of the TV program did not by itself account for any of the results described below. Another important consideration is that because play episodes and episodes of focused attention were coded so that they ended if the child looked at the TV longer than 3 s, it is possible that effects of TV in reducing play or focused attention length are due to these longer looks at the TV (about 30% of all looks). Consequently, we performed analyses considering only looks at the TV that were less than 3 s in length as well as only those longer than 3 s. There were no substantial differences in results from those reported below; that is, looks at the TV that lasted less than 3 s had about the same effects per look on the dependent variables as looks longer than 3 s.

Play and Focused Attention as a Function of Condition

The first set of HLM analyses on play episodes and focused attention considered the dependent measures as a function of condition (TV and no TV). For these analyses, Level 1 (within-subjects) HLM predictors included condition, linear change over time (6-min intervals), quadratic change over time, and interactions between these factors. Level 2 (between-subjects) predictors included age and sex of the child, order of conditions (TV first and TV second), parent education (i.e., highest level achieved), familiarity with the toys in the playroom (i.e., how many of the toys were similar to ones the child had at home), exposure to TV at home (i.e., average of parent-reported hours for each day of the week), and how frequently the child looked at the television in the lab (i.e., total number of looks at the screen as an individual difference measure). All the above factors were assessed as predictors of the outcome measures, but only those that significantly improved the overall model were included in the final models. Specifically, to minimize the chance of Type I error due to multiple tests, only those predictors that significantly contributed to the total amount of variability explained by the model, based on HLM hypothesis testing, are presented here.

Percent of interval spent in play. The percent of each interval spent engaged in toy play decreased over time spent in the room, $B = -0.84$ ($SE = 0.33$), $t(49) = -2.58$. Condition was also a significant Level 1 predictor in the final model for percent of time spent in toy play, $B = -5.08$ ($SE = 1.86$), $t(49) = -2.73$. In this model, condition explained an additional 4.06% of within-subjects (Level 1) variability not accounted for by the model without TV (i.e., after controlling for time). Children played less by about 5 percentage points, or 18 s per 6-min interval, when the TV was on. Because play decreased by about the same amount as the children looked at the TV (i.e., 5% of the session), it seems likely that looking at the TV simply displaced ongoing play.

Length of play episodes. A small decrease in the total amount of play in an interval does not necessarily mean that the length of play episodes decreased. Consequently, play episode length was analyzed separately as a function of condition. The final model for mean play episode length included linear and quadratic change as significant Level 1 predictors, $B = 27.61$ ($SE = 6.95$), $t(46) = 3.97$, and $B = -2.76$ ($SE = 0.76$), $t(46) = -3.64$, for linear and quadratic slopes, respectively. Furthermore, at Level 2, the size of the linear and quadratic slopes was predicted by an interactive combination of age and sex, $B = -23.57$ ($SE = 8.66$), $t(46) = -2.72$, and $B = 3.33$ ($SE = 1.03$), $t(46) = 3.22$, for the Age $\times$ Sex interaction on linear and quadratic coefficients, respectively. The overall change over time was such that the average length of play episodes increased until just after the midpoint of the 60-min session and then decreased. The Age $\times$ Sex effects were due to 3-year-old girls showing the most dramatic changes over time, whereas younger children and boys showed relatively less change over time. Adjusted for these effects, background television decreased play episode lengths such that play episodes were approximately 30 s shorter on average in the TV condition, $B = -30.16$ ($SE = 7.39$), $t(49) = -4.08$. Condition explained an additional 4.30% of within-subjects variability not accounted for by the model without TV. The only residual variance remaining to be explained by the final model was for the effect of TV suggesting that other factors, such as individual differences not captured by age, sex, toy familiarity, home TV exposure, and parent education, may play a role in the effect of background TV. In sum, play episode lengths changed over time in an inverted-U fashion, particularly for older girls, and became substantially shorter in the presence of background television when controlling for these general changes over time.

Percent of play that was focused. Because background TV reduced the total amount of play, we analyzed the percent of play that was accompanied by focused attention. The final model for percent of focused play included only linear change as a predictor at Level 1. Significant Level 2 predictors in the final model included the effect of age on the intercept and an Age $\times$ Sex interaction on the slope for time. The amount of play that was focused increased by

about 11% per year of age, $B = 10.98$ ($SE = 3.99$), $t(48) = 2.75$. In addition, the percent of play that was focused decreased linearly over time, $B = -0.82$ ($SE = 0.38$), $t(46) = -2.16$. This was particularly true of males and younger females, $B = -1.59$ ($SE = 0.63$), $t(46) = -2.52$. The effect of TV condition and the quadratic slope was not significant for the percent of play that was focused, although significant variability remained to be explained suggesting that changes occurred in different directions for individual children. No Level 2 variables in the current study were able to sufficiently predict these changes.

Length of focused episodes. Even though the percent of focused play changed little in the presence of TV, the lengths of episodes of focused attention were affected. The final model for all data for mean length of focused episodes included linear and quadratic change over time and condition at Level 1. Similar to the results for mean play episode length, in this model, the quadratic slope was negative such that initially length of focused attention episodes increased until just after the midpoint and then decreased, $B = -0.40$ ($SE = 0.19$), $t(48) = -2.13$. Furthermore, age was a significant Level 2 predictor of the quadratic slope insofar as the changes over time were more dramatic for older children, $B = -0.65$ ($SE = 0.17$), $t(48) = -3.87$. Adjusted for these effects, television decreased the mean length of focused attention episodes by approximately 5 s (almost 25%) during the first interval, $B = -5.06$ ($SE = 2.17$), $t(49) = -2.33$. Condition accounted for an additional 5.73% of within-subjects variability. There was significant variability remaining to be explained for change over time and the effect of TV. Again, these are likely due to unexplained individual differences.

Play and Focused Attention in the Presence of TV as a Function of Looks at the Screen

The second set of HLM analyses was conducted using only the data from the TV sessions for each subject. Rather than assessing play behavior as a function of condition, in this second set of analyses, the number of looks at the TV screen was included as a Level 1 predictor to determine the extent to which this measure of distraction by the TV predicted variation in outcome measures when the TV was on. In other words, for each participant, the outcome measure within a 6-min interval (e.g., percent of that interval spent in play) was assessed as a function of the number of looks at the TV that occurred during that same 6-min interval. Other within-subjects predictors were linear and quadratic change over time and interactions between time and looks at TV. Between-subjects factors at Level 2 included order of conditions, parent education, toy familiarity, and home TV exposure.

Percent of interval spent in play. When considering data from the TV condition alone, the amount of time spent in play decreased significantly over time, $B = -2.21$ ($SE = 0.97$), $t(49) = -2.28$. In addition, the percent of the interval spent in play significantly decreased by an average 2.3% with each additional look at the TV screen in an interval (see Figure 2), $B = -2.31$ ($SE = 0.38$), $t(49) = -6.15$. Children spent more time engaged in toy play during intervals in which they had relatively few looks at the TV screen as compared to intervals during which they had more looks at the screen. The number of looks at the screen accounted for 14.27% of within-subjects variability remaining to be explained after controlling for change over time. Similar to findings reported above, the negative effect of look number on play behavior held even when excluding data from the first 6 min of the session during which looks at the TV were particularly high as well as when considering only those looks that were less than 3 s in length.

Length of play episodes. The number of looks per 6-min interval was also a significant negative predictor of the length of play episodes in the TV condition (see Figure 3), $B = -3.32$ ($SE = 0.94$), $t(49) = -3.54$. For each additional look at the TV in an interval, the mean length of play episodes in that interval dropped by an

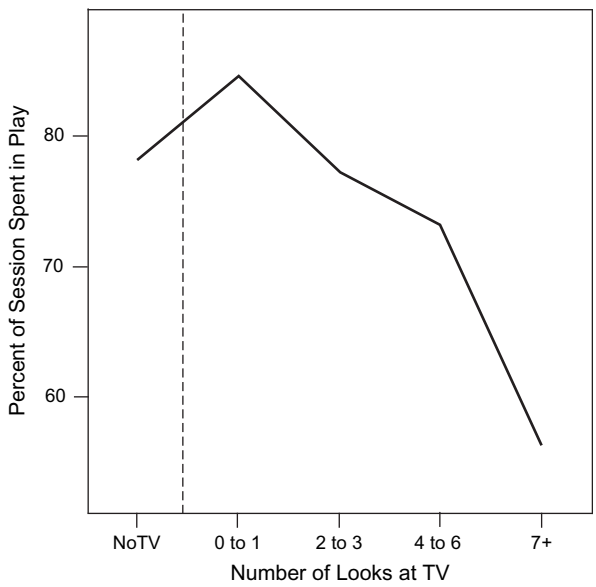

Figure 2. Mean percent of 6-min intervals spent in play as a function of the number of looks at the TV.
Note. Values are unadjusted by hierarchical linear modeling coefficients. Average percent of session spent in play for the no TV condition is provided for reference.

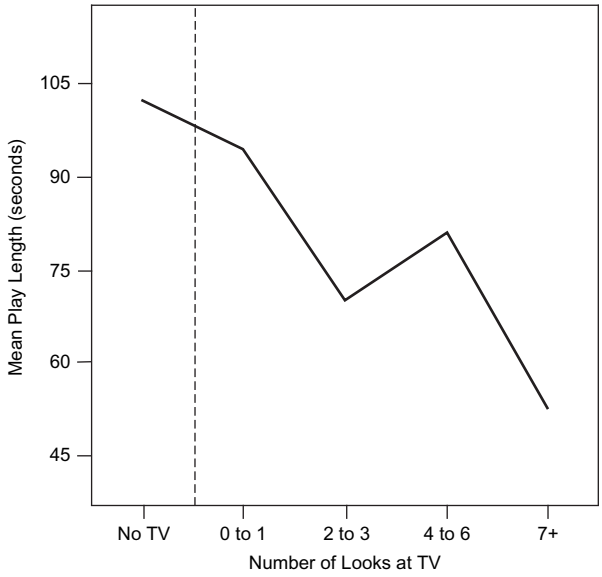

Figure 3. Mean length of play episodes per 6-min interval during the TV condition as a function of the number of looks at TV during that interval (values are unadjusted by hierarchical linear modeling coefficients).
Note. Average episode length during the no TV condition is provided for reference.

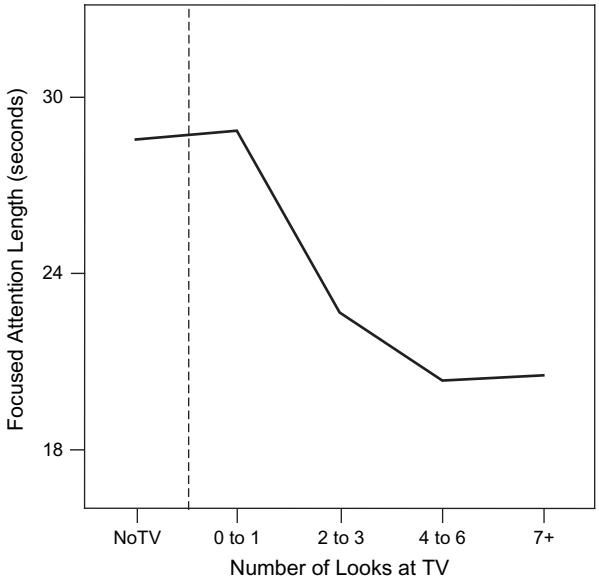

Figure 4. Mean length of focused attention episodes per 6-min interval during the TV condition as a function of the number of looks at TV during that interval.
Note. Average episode length during the no TV condition is provided for reference. Means are unadjusted by hierarchical linear modeling coefficients.

average of 3.3 s. The number of looks at the screen per interval accounted for an additional 4.57% of within-subjects variability.

Percent of play that was focused. As with the HLM analysis on the entire session, the percent of play in the TV condition that was focused increased with age, $B = 10.88$ ($SE = 3.07$), $t(48) = 3.55$. Although the percent of play that was focused in the TV condition did decrease somewhat as a function of the number of looks at the screen, this effect was not significant.

Length of focused play episodes. The quadratic slope was significant reflecting the same inverted-U changes over time that were found in the first analysis on length of focused episodes, $B = -13.41$ ($SE = 3.56$), $t(48) = -3.77$, and $B = 3.20$ ($SE = 0.79$), $t(48) = 4.06$, for linear and quadratic slopes, respectively. Furthermore, the number of looks at the TV was a significant predictor of the length of focused attention as shown in Figure 4, $B = -1.14$ ($SE = 0.45$), $t(48) = -2.53$. The length of focused attention episodes decreased by an average 1.14 s per look at the TV. The number of looks at the screen accounted for 19.91% of within-subjects variability remaining to be explained.

Maturity of Toy Play

Weighted average play maturity. Because exploratory analyses of maturity of toy play indicated that there were no order effects indicative of systematic changes over time, the results presented are from mixed ANOVAs. For average play maturity (weighted by the time spent at each level of maturity), the analysis was a 3 (age) $\times$ 2 (sex) $\times$ 2 (order of conditions) $\times$ 2 (condition) ANOVA with condition as a repeated measure. The only significant main effect for average maturity level was age, $F(2, 38) = 42.87$. Post hoc analyses revealed that the 12-month-olds (mean level = 2.62) differed significantly from the two older age groups but that the 24- and 36-month-olds were not significantly different from each other (mean levels = 4.86 and 5.28, respectively). There was also a significant interaction between age and order of conditions, $F(2, 38) = 4.90$. Average maturity of play by 36-month-olds was greater when the TV condition was presented first than when it was second. There were no significant main effects or interactions with respect to the presence or absence of background television.

Time spent at each level of play. Exploration of the play maturity data indicated that the children spent the vast majority of their play at only 4 of the 14 levels: Level 2 (simple manipulation), Level 3 (functional), Level 5 (functional-relational), and Level 10 (sequence pretend). Level 3 refers to appropriate play with an object according to its standard intended use. An example is turning the crank on a jack-in-the-box.

Level 5 refers to play that puts two or more objects together in an appropriate manner (e.g., putting lids on pans). Level 10 refers to play that involves pretend acts in a related series (e.g., picking up doll, getting bottle, feeding doll with bottle, putting doll in bed). Together, these four categories accounted for 84, 82, and 83% of total play for 12-, 24-, and 36-month-olds, respectively. An ANOVA was conducted to determine whether TV had a differential effect on any of these four levels of play maturity. Time spent at each of these four levels was subjected to a 3 (age) $\times$ 2 (sex) $\times$ 2 (order) $\times$ 2 (condition) $\times$ 4 (level of play: 2, 3, 5, and 10) ANOVA with condition and level as repeated measures.

The omnibus ANOVA revealed a significant Condition $\times$ Level interaction that was explored by ANOVA on each level independently. Because of the large number of subordinate tests run, a more stringent significance level of .01 was adopted. There was a significant main effect of age for Levels 2, 5, and 10, $F(2, 38) = 40.89$, $F(2, 38) = 16.79$, and $F(2, 38) = 14.44$, respectively. Post hoc analyses (t tests with Bonferroni correction) revealed that 12-month-olds engaged in significantly more play at Level 2 (51% of play vs. 24% and 18%) and significantly less play at Levels 5 (8% vs. 22 and 31%) and 10 (0.5% vs. 14 and 16%) than 24- and 36-month-olds. The two older age groups did not differ significantly at any level.

The only level of play maturity demonstrating a significant effect of TV was Level 3 (functional play). For functional play, there was a significant Condition $\times$ Order interaction such that there was more play at this level in the second session compared to the first, particularly when TV was presented second, $F(1, 38) = 16.80$. In the first half hour, Level 3 accounted for 17% of play for children with TV and 16% for children without TV. In the second half hour, children with TV spent 31% of play at Level 3, whereas children without TV spent 24% of play at Level 3. A compensatory decrease in Level 5 play in the presence of TV approached significance, $F(1, 38) = 5.19$.

Discussion

We found that very young children's toy play was disrupted by background television. Specifically, compared to no television, there was less play overall, shorter play episodes, and shorter bouts of focused attention in the presence of background television. Given these findings, it was surprising that there was little overall reduction in focused attention and that maturity of play was affected in a limited way. Although there was some reduction in functional-relational play in the presence of television with a compensatory increase in functional play, there was no reduction in complex, high-level play as predicted. Overall, the disruptive effects are real but small.

We hypothesized that background television would disrupt play by repeatedly eliciting an OR toward the television screen and away from ongoing play activities. The hypothesis was supported insofar as children frequently oriented toward the TV screen for short periods of time, although there was a reduction of such looks after the first 6 min of the program. The more frequently the child looked at the TV screen, the greater was the disruption of play.

The overall reduction of play in the presence of background television is likely due to displacement by looking at the screen. The cumulative time spent playing was reduced by about 5% in the half hour that the television was on, just about the same as the 5% of time spent looking at the television. Although an important finding on its own, this reduction in overall time spent playing is not sufficient to account for the reduced length of play episodes. The overall reduction in play also does not account for the reduction in lengths of focused attention or the slight reduction in play maturity. It is likely that in very young children, brief looks at background television disrupt ongoing play schemes. When the child stops looking at the TV, he or she may have forgotten the ongoing play scheme or otherwise find it difficult to reinstantiate the scheme in which case a new scheme is initiated with another toy. In fact, in the presence of television, children were more likely to move from toy to toy, coming into contact with an average of 65% of the toys as compared to 55% when the television was not on.

Background television has been shown to reduce adults' performance on a variety of complex cognitive tasks. This has been interpreted as the television competing with the primary task for cognitive resources (e.g., Armstrong & Greenberg, 1990). Assuming that toy play is cognitively demanding in very young children, interference with play could be expected as well. Background television may also be implicated in a more general kind of interference associated with noisy environments. Children exposed to excessive noise (e.g., from airports or motor traffic) do less well on tests and on tasks requiring concentration (Hygge et al., 2002). With respect to very young children, the level of ambient noise in the home is negatively related to cognitive development (Gottfried, 1984; Wachs, 1985, 1986; Wachs & Gandour, 1983). In a related vein, Landry, Smith, Swank, and Miller-Loncar (2000) found that the extent to which parent interactions disrupt children's ongoing play

negatively predicts children's subsequent cognitive and language skills. These authors proposed that interrupting children's play requires them to repeatedly refocus attention and may tax children's limited cognitive resources. Background television may have an analogous effect.

This research raises the question of the influence of background television in children's natural environments. Assuming that the effects found in this experiment occur at home, it is as yet unknown whether chronic reductions in play episode lengths and focused attention lengths produced by background television are parts of a causal chain leading to negative long-term consequences. Nevertheless, short play episode lengths are a marker for poor developmental outcome (e.g., Faden & Graubard, 2000; Handen et al., 1998; Malone, 1997) as is reduced focused attention during play (Lawson & Ruff, 2004). Moreover, children's sustained attention has been shown to mediate effects of family environment (composite of physical environment and caregiver responsiveness) on school readiness (National Institute of Child Health and Human Development Early Child Care Research Network, 2003).

Although the present research shows that background television plays a proximate causal role in reducing play episode length and focused attention, it remains for future research to determine whether this suite of effects is by itself causal in poorer developmental outcomes. Prior research on background noise in the home, of which background television is a considerable component, has identified a negative relationship between such noise and mothers' verbal responsiveness to the child (Corapci & Wachs, 2002). This suggests that background television may exert an influence beyond its direct effects on very young children's solitary toy play as observed in the present work. Indeed, in a subsequent experiment following a design parallel to the present study, we found that the quality and quantity of parent–child interactions are also affected as parents watch or become distracted by television (Kirkorian, Murphy, Pempek, Anderson, & Schmidt, 2005). It is also possible that chronic exposure to television that is constantly left on in the home is correlated with other factors, such as a generally chaotic home environment (Wachs, 1986). Taken together, however, reduced parent–child interactions, combined with reduced focused attention during play and reduced play episode length, lead us to hypothesize that background television, as a chronic influence, is by itself an environmental risk factor in children's development.

It is possible, of course, that background television does not induce effects that are necessarily negative but instead induces a characteristic style of attention deployment, a style that may be appropriate in some situations but not in others. Correa-Chavez, Rogoff, and Arauz (2005), for example, argue that the attentional style of traditional village-reared Latin American children differs from that of European American children with parents who have received extensive schooling. These distinctions (attending sequentially vs. simultaneously to multiple information sources) are produced by substantially different childhood experiences and may prove optimal in different situations (e.g., learning in school vs. observationally learning from village activities). From this point of view, background TV may induce an attentional style that is not necessarily negative in all situations. For example, it is possible that it can provide some basis for later multitasking skills. Contemporary American youth are characterized as simultaneously talking on cell phones and playing computer games even as they monitor TV (Foehr, 2006). It has not yet been shown whether such media multitasking is associated with generally positive or negative outcomes.

Our basic conception of background television is that it functions as a continuously varying distractor for very young children. Whereas it is thought that distractibility decreases with age, and the evidence supports this in school-aged children (e.g., Strutt, Anderson, & Well, 1975), Ruff and Rothbart (1996) note that there is little evidence for a developmental trend in distractibility for children aged 5 years and younger. In the present study, if looking away from toy play to the television is taken as a measure of distraction, the 3-year-olds looked fewer times than younger children. Consistent with Ruff and Rothbart's model of attention development, play length and focused attention also increased with age. However, we did not find an age difference in the disruptive effects of background television, a continuously changing audiovisual distractor. Rather, all ages had reduced play episode and focused attention lengths.

It is possible that these effects are uniquely produced by television as a distractor. Ruff and Capozzoli (2003) examined the effects of an intermittent audiovisual distractor on the toy play of 10-, 26-, and 42-month-olds. Like the present study, they found a decrease in distractibility over time; their experimental session was 12 min in length. However, they found no difference in distractibility as a function of age as evidenced by looks at the distractor. Ruff and Capozzoli (2003), moreover, found that the intermittent distractor did not reduce either length or amount of focused attention during play. It could be that the difference between studies is due to the continuously changing nature of background television, but the

differences might also be due to several factors including the longer observation period, a greater number of toys in the present experiment, general age differences, or other procedural differences.

In conclusion, even though the effects of background television on play behavior found in this study are small, they may have a cumulative impact through large amounts of exposure at home. These may include poorer cognitive and language development and attention deficit symptoms as found in associations from a small number of studies that focus on very young children (Carew, 1980; Christakis et al., 2004; Nelson, 1973; Wachs, 1985, 1986; Zimmerman & Christakis, 2005). Researchers to date, lacking direct evidence, have tended to attribute these associations to negative effects of television programs made for young children and to which they are highly attentive (e.g., Christakis et al., 2004). The present research, in contrast, is suggestive that programs made for adults and watched by parents may in fact provide a risk factor for development and could conceivably account for the negative associations with cognitive and language development. This study demonstrates that it is imperative for future research on the influence of media in the home to distinguish between the possibly greatly differing effects of foreground and background television exposure.

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Appendix

	Coefficient (*SE*)	Significance test
Constant		
Intercept	57.32 (10.76)	$t(47) = 5.36, p < .001$
Age	−1.05 (0.28)	$t(47) = -3.73, p = .001$
Order	−48.09 (9.65)	$t(47) = -4.98, p < .001$
Time		
Intercept	−12.27 (2.59)	$t(48) = -4.73, p < .001$
Order	7.86 (1.69)	$t(48) = 4.66, p < .001$
Time squared		
Intercept	0.70 (0.15)	$t(49) = 4.57, p < .001$

The table in this Appendix presents the HLM final model for the number of looks at the screen in the TV condition. Order is a dichotomous variable such that a value of 1 represents the TV first order, whereas a value of 0 represents the TV second order. Centering, or transforming variables such that a value of 0 represents a point (actual or estimated) in a data set, is a common practice in HLM analyses. This allows the constant (i.e., the value of the outcome measure when all other variables are set to 0) to be a meaningful value. In this case, age is represented in years and centered at its mean such that a value of 0 represents age 2 years, 1 year of age is represented by a value of −1, and 3 years of age is represented by a value of 1. Time is centered at the first interval of the TV condition such that a value of 0 represents the average for the first 6 min that the TV was on, a value of 1 represents the second 6-min interval, and so on.

Coefficients for "intercept" are the intercepts of the Level 2 equations; coefficients for all other factors are the slopes associated with those predictors. Level 1 (within-subjects) variables can be interpreted in much the same way as in regression analyses. Level 2 (between-subjects) predictors can be interpreted as regression coefficients for the Level 1 slopes. The constant represents the value of the outcome measures when all predictors are set to 0 (the intercept in a standard regression equation). For example, based on the above model, the average number of looks at the screen in the first interval of the TV condition (Time 0) for 2-year-olds (age 0) when TV was presented in the second half hour (Order 0) was about 57. When TV was presented in the first half hour (i.e., when order has a value of 1), the constant is reduced by about 48, resulting in an average of only 9 looks in the first interval for 2-year-olds. The negative slope for age on the constant indicates that the average number of looks decreased with age (approximately one look per 6-min interval per year of age).

There was also a significant negative linear component, indicating that the number of looks generally decreased over the course of the TV condition. Order is a positive predictor of that slope. When TV is presented in the second half hour (i.e., when order is 0), the linear slope is about −12.3; when TV is presented first (i.e., when order has a value of 1), the linear slope increases by a factor of about 7.9, making it only −4.4 for this order. Thus, the number of looks generally decreased with time that the TV was on but less so when TV was presented first than when it was presented second. Last, the positive slope for time squared suggests a U-shaped function with respect to time; this is manifest in a large decrease in looks from the first interval to the second and relatively little change over time thereafter.