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The Relations of Television Exposure in Infancy and Toddlerhood to Early Elementary Cognitive Outcomes

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The Relations of Television Exposure in Infancy and Toddlerhood to Early Elementary Cognitive Outcomes

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The Relations of Television Exposure in Infancy and Toddlerhood to Early Elementary Cognitive Outcomes

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Despite a growing body of research regarding the effects of media on very young children, most studies have focused on relatively short-term effects, and those that examined long-term effects have not done so with a representative sample. The current study examined long-term effects of screen media exposure on children aged 0 to 35 months.

The data for this study came from the first and second waves of the Panel Study of Income Dynamics (PSID) Child Development Supplement (CDS-I and CDS-II), which offers several advantages in examining the longitudinal relationships between early television exposure and subsequent academic performance. This nationally representative dataset includes a measure of cognitive skills, as well as time diaries that provide a record of how and with whom children spent their time. First, this study examined television viewing contexts likely to be operative in infancy and toddlerhood – what these children view, whom they co-view with, what they co-view, and what they are doing while the television is on. Second, this study assessed the long-term effects of early exposure to different program content (i.e., child-educational programs, child-noneducational programs & adult programs) on subsequent cognitive outcomes (mainly academic achievement) in early childhood. Finally, the role of parental co-viewing in the

long-term effects of exposure to child-educational content on academic skills was examined. Descriptive analyses and multiple OLS regressions were conducted.

On weekdays, children were exposed to child-educational content, child-noneducational content and adult content on TV (33 minutes, 29 minutes, 27 minutes, respectively); on weekends, children were exposed to child-educational content, child-noneducational content and adult content on TV (23 minutes, 31 minutes, 31 minutes, respectively). Although it is commonly believed that television displaces time spent with others and playing, nearly half of infants and toddlers' time spent viewing television was spent playing and in social interaction (30% and 16%, respectively).

Different relationships emerged among groups with differing amounts of total television exposure: children who were exposed to 1 to 2 hours of television per day had higher academic test scores compared to children who were exposed to less (those who watched no TV at all and those who were exposed to between 0 and 1 hour). As regards television content, the only relationship found was among toddlers exposed to adult content. Toddlers who were exposed to more adult programs in their early years were likely to have worse passage comprehension test scores 5 year later. However, there was no relationship between early exposure to child programs (i.e., child-educational and child-noneducational content) and subsequent academic test scores.

Parental co-viewing of child-educational content was positively related to the academic achievement test scores (the passage comprehension test scores and the applied problem scores), indicating that parental co-viewing plays an important role in children's experience of media in infancy and toddlerhood. The findings have implications that may allow us to increase the effectiveness of learning from screen media in infancy and toddlerhood.

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Chapter 1: Introduction

STATEMENT OF THE PROBLEM

Families today are assimilating, at an astonishingly rapid pace, media into their homes and daily lives. Television, radio, video games, electronic toys, and computers have turned many modern homes into electronic entertainment and information zones. Even when not in active use, media are present in various forms: the TV left on, a screen saver going, or a radio playing in an empty room. There may be little waking time in the lives of many infants and toddlers in which they do not feel the presence of media. What, then, are the effects of such an all-encompassing presence on very young children? Despite agreement among researchers on the importance of this question, little research has focused on the impact of media exposure on infants and toddlers.

For the past half a century, infants and toddlers have been exposed to TV shows targeting their older siblings and parents. More recently, however, infants and toddlers themselves have become a target audience (think of *Teletubbies* or *Baby Einstein*). The availability of this new content adds to growing concerns among scholars about the amount of exposure young children already have to "background" television that, although it is not specifically directed at them, distracts from their play whenever it periodically gets their attention (Anderson & Pempek, 2005).

Various types of screen media targeting very young children have seen an upsurge (e.g., the *BabyFirstTV* 24-h channel, portable DVD players). Recently, two comprehensive reports by the Kaiser Family Foundation (Rideout, Vandewater, & Wartella, 2003; Rideout & Hamel, 2006) confirmed that a large proportion of American infants and toddlers spend part of every day in front of screens, watching new types of visual materials specifically designed to capture and hold their attention. On a typical day, more than half (60%) of these kids watch TV or videos from one to two hours. Secondary viewing (background TV) commonly begins as early as three months. Forty percent of children live in a heavy TV-viewing household (a TV is on nearly all the time). Nearly nineteen percent of children a year or younger (and 29% of 2- and 3-year-olds) have working television sets in their bedrooms. Children in this age group spend a large part of their day sleeping or being engaged in general childcare activities, such as diapering and feeding. Hence, even a few hours of television exposure represents a relatively large proportion of their waking time. Given this fact, the cumulative impact of screen media on very young children may be substantial. But what exactly is the impact of early screen media exposure on children's development?

Scholars are now engaged in a vigorous debate on this issue. The debate centers on the negative and positive potentials of television and videos, and how screen media may affect the cognitive development of very young viewers. Research on the impact of

media on preschoolers and school-aged children has a long history (Pecora, 2007). Nevertheless, the ongoing debate has only recently incorporated infants and toddlers, the newest target audience for video and DVD materials (Courage & Setliff, 2009).

On one side, there are the policy statements made by the American Academy of Pediatrics (AAP, 1999, 2001, 2011). The AAP recommends that children under two avoid screen media completely. Children over age two, according to the AAP, should watch less than two hours of high-quality programming per day. Continuous exposure to fast-changing images, the AAP holds, may contribute to problems with attention development later (Christakis, Zimmerman, DiGiuseppe, & McCarty, 2004). Moreover, they assert, time spent viewing is time taken away from more interactive and brain-enriching activities such as parent-child interaction, play and reading (or being read to). The AAP's recommendations are supported by recent research, which has found that the amount of focused attention on toys was significantly reduced when an adult-directed program (in the form of background TV) was on. The quality and quantity of parent-child interactions also dropped off (Kirkorian, Pempek, Murphy, Schmidt, & Anderson, 2009; Schmidt, Pempek, Kirkorian, Lund, & Anderson, 2008). Additionally, there is a small but growing body of research demonstrating that infants and toddlers learn less information from television than from live face-to-face interactions (a phenomenon known as the

video deficit effect) (Anderson & Pempek, 2005; Courage & Howe, 2010); this finding also gives weight to the AAP's recommendations.

On the other side of the debate are those advocating age-appropriate educational media for infants and toddlers. These proponents of screen time for young children, many of whom are marketers of media content aimed at infants and toddlers, see it as an opportunity to enhance learning and brain development (Garrison & Christakis, 2005). Although their claims have yet to be confirmed, they seem to have convinced parents. Recent diary studies reported that families owned, on average, 5-6 age-appropriate videos for their infants and toddlers (Barr, Chavez, Fujimoto, Garcia, Muentener, & Strait, 2003; Pierroutsakos, Hanna, Self, Lewis, & Brewer, 2004). Half the parents with children under six considered educational television and videos to be "very important" for their children's intellectual growth (Rideout, Vandewater, & Wartella, 2003; Vandewater, Park, Huang, & Wartella, 2005). These results clearly demonstrate that parental belief in the benefits of educational media is widespread.

Advocates of educational television and video/DVD programs for very young children point to three positive findings from the extant research: (a) greater academic performance and school readiness among preschoolers who watched *Sesame Stree*t and other educational shows (Anderson, Huston, Schmitt, Linebarger, & Wright, 2001; Wright, Huston, Murphy, St. Peters, Pinon, Scantlin, et al., 2001); (b) the positive

association between infants' and toddlers' viewing certain types of television content (e.g., *Blue's Clues*) and subsequent language development (Linebarger & Walker, 2005); and (c) certain circumstances, such as repetition or parental co-viewing, that can enhance infants' and toddlers' ability to learn from screen media and can also ameliorate the video deficit effect (Krcmar, Grela, & Lin, 2007; Lemish, 1987). These findings, along with studies substantiating infants' remarkable ability to learn and remember (Bauer, 2007), make the notion of optimizing early learning through high-quality video material both plausible and attractive to parents.

In short, screen media exposure is almost certainly inevitable for many infants and toddlers, given the current climate: videos and DVDs targeting these young children are proliferating, along with extravagant claims about their benefits, and parents are buying both the claims and the videos. Media research on infants and toddlers, however, has yet to catch up to the realities of the situation. Scholars have just begun to focus on how these young children learn from media and to examine what is actually learned. There is still a paucity of research on how early screen media exposure can promote or hinder subsequent cognitive development, although a substantial body of literature has documented the adverse effects of non-educational media in preschool and school-aged children on later cognitive outcomes (including academic achievement, language, and behaviors) (e.g., Anderson et al., 2001; Wright et al., 2001; Zimmerman & Christakis,

2005). Emerging research suggests the potential for adverse effects of media beginning in infancy (Christakis, Gilkerson, Richards, Zimmerman, Garrison, Xu, et al., 2009; Mendelsohn, Berkule, & Tomopoulos, 2008; Schmidt, Rich, Rifas-Shiman, Oken & Taveras, 2009; Tomopoulos, Dreyer, Berkule, Fierman, Brockmeyer & Mendelsohn, 2010). However, many of these studies have been primarily cross-sectional; moreover, they typically fail to include detailed information regarding content (Barr, Lauricellas, Zack, & Calvert, 2010). There is currently a need for longitudinal studies that examine both the context and the specific content of early screen media exposure (mainly to TV and video/DVDs) and cognitive outcomes.

The present study has several goals to help fill the gaps in our understanding of the potential impact of early media exposure on cognitive development. The first goal of this study is to provide comprehensive information regarding television viewing contexts likely to be operative in infancy and toddlerhood – what these children view, whom they co-view with, what they co-view, and what they are doing while television is on (i.e., secondary activities). The second goal is to examine the long-term effects of early television exposure to different types of content (i.e., exposure to child-educational programs, exposure to child-noneducational programs, exposure to adult programs) along with the effect of overall television exposure on subsequent cognitive outcomes. The

third goal is to assess the role of parental co-viewing in the long-term effects of exposure to child-educational content on academic skills.

SIGNIFICANCE OF THE STUDY

Previous research examining television exposure and academic achievement tends to fall in one of two categories. There is a body of survey data gathered from large, representative samples, with relatively superficial measures of viewing. In many studies, for example, viewing measures consist of one or a few questions asking individuals how much time they spend watching television. Written or oral viewing diaries are far more accurate (Anderson, Field, Collins, Lorch & Nathan, 1986; Wright, et al., 2001), but few studies have used them. Another potential limitation of the studies using representative samples is that they fail to control for characteristics that might produce a spurious relationship between media use and academic skills (e.g., demographics, the home environment, parent depression, and child IQ) (Huston & Wright, 1997; Linebarger & Vaala, 2010).

Another body of work uses more detailed of measures of media use, but it is limited in generalizability by its reliance on small convenience samples (Huston & Wright, 1997). Although there are indications that screen media are particularly influential on very young children (Wright et al., 2001), few investigations of specific television content include infants and toddlers in the sample.

The current study utilizes the first and second wave of the Panel Study of Income Dynamics (PSID) Child Development Supplement (CDS-I and CDS-II), which can help to fill gaps in the existing research and which also offers several advantages in examining the longitudinal relationships between early television exposure and subsequent academic performance. The CDS provides rich data regarding very young children's media contexts (i.e., whom they coview with, and what they are doing while television is on) and television content. Most surveys in the area of media studies, even though they provide good information about media activities, have relatively poor information on children's characteristics and developmental outcomes. However, the CDS data provide not only information about children's media use but also other activity level variables (e.g., time spent in playing and time spent in reading or being read to), along with socio-economic and contextual variables related to children's developmental outcomes.

Secondly, the CDS provides longitudinal data on a nationally representative sample of children. This study takes advantage of the uniqueness of the PSID-CDS data, which is especially important, given that there are only a small number of empirical studies to date utilizing representative samples of infants and toddlers in the area of early television exposure and cognitive development. In addition, two waves of the CDS data allow consideration of the influence of screen media exposure in infancy and toddlerhood on subsequent cognitive outcomes at ages 5-8 years old.

Finally, one of the strongest elements of these CDS data is that they include 24-hour time-use diaries used to document very young children's time. Time-use diaries are considered a highly reliable method of gathering this type of data, because they are less subject than surveys to estimate error due to recall and distortions of social desirability (Nie, Hillygus, & Erbring, 2002; Vandewater & Lee, 2009). An accurate measure of time and a full count of time can be obtained from the PSID time diaries.

In sum, the current study leverages reliable, representative, and longitudinal data to add to our understanding of the ways in which early television exposure affects children's developmental outcomes.

The next chapter will review existing studies on the impact of early media exposure on cognitive development. The literature review focuses mainly on children under three, but relevant research on older children has also been included. Based on the review, the research questions and models examined in the present study will be significant new additions to our understanding of the impact of screen media on very young children. Chapter 3 will address the sample of the present study, the measurements of the variables and analysis plans for each research question and hypothesis. Chapter 4 presents a descriptive analysis of variables and findings from analyses addressing research questions. The final chapter will discuss the implications and provide suggestions for future research.

Chapter 2: Review of the Literature

SCREEN MEDIA AND VERY YOUNG CHILDREN

The first three years of life are considered to be a period of rapid brain development (Barton & Brophy-Herb, 2006; Shonkoff, 2003). When a baby is born, his brain is still in an embryonic stage. During the baby's first few years, however, his brain completes the majority of its development. In response to environmental stimuli, synapses form at an astonishing rate. Environmental stimuli include interactions with caregivers, experiences manipulating objects like blocks or puzzles, and creative problem-solving activities.

When we consider the fact that children's earliest experiences can quite literally shape their brains, it is hard to overlook recent reports telling us that screen time accounts for a significant portion of a child's early years (Rideout & Hamel, 2006; Rideout et al., 2003). What effects are TV and video/DVDs having on the development of neural connections? Are the synapses that may be strengthened by screen time the ones that will be most useful to the child, or are those neural connections being made at the expense of those that would have developed through real-world interactions? No research has answered these questions yet. We do not even know whether the neural connections being made when young children view video images are different from those made when

they watch other images -- for example, a dog running around the house. Again, there is no credible evidence showing that a brain is being wired "incorrectly" when a young child watches television or videos. Even so, we still need to be aware of screen time's effects.

THE IMPACT OF SCREEN MEDIA

To begin to understand whether screen media influence infants' and toddlers' development, and if so, exactly how they affect these very young children, it is important to understand that not all screen media are created equal. In fact, screen media manifest their effects on very young children primarily according to content. Previous studies attempting to estimate children's screen media exposure have usually failed to consider the type of material viewed, and have usually made no distinction between foreground and background television, leaving the precise meaning of "watching television" unclear, resulting in mixed results regarding the impact of early screen media exposure on subsequent cognitive outcomes (Anderson & Pempek, 2005; Barr et al., 2010).

Content

The effects of screen media on children have primarily to do with the program's content. Screen media can be categorized according to the content's target audience: there are infant-directed, child-directed, and adult-directed programs. Infant-directed

programs (i.e., baby videos such as *Baby Einstein* or *Brainy Baby*) targeting infants and toddlers have recently emerged in the market (in 1997). They are characterized by frequent scene, character, or object changes, with many salient features, both perceptual (e.g., sound effects, background music, voice-overs) and visual (e.g., colors, babies, pictures of objects or animals). The backdrops or sets are either familiar or relatively simple (e.g., simulated family room, white background). This type of program also features objects or events that are categorically related (e.g., household items, animals) with little narrative (Goodrich, Pempek, & Calvert, 2009; Vaala, Barr, Fenstermacher, Brey, Salerno, Garcia, 2010).

Child-directed programs target preschoolers and older children (e.g., *Sesame Street*, *Dinosaur Train, Clifford the Big Red Dog)*. Like programs that target babies, these are characterized by very dense concentrations of perceptually-salient formal features. Their story lines, however, are more complex, relying more heavily on narrative and expository formats than do infant-directed programs (Goodrich et al., 2009; Linebarger & Vaala, 2010). Adult-directed programs, of course, target adults (e.g., the news, sitcoms, game shows and so forth). As with the other two categories, content here is highly variable.

In addition to these three commercially-produced categories, there is a fourth category created by researchers. The content in this category is an experimental investigation into whether infants and toddlers learn from screen media, and, if so, how

this learning takes place in a controlled setting. For example, researchers very carefully design this content to convey a limited amount of quite specific information using simple video scripts to teach children (i.e., imitation of a modeled response, object retrieval or word learning). Some have claimed that studies showing positive effects of researcher-designed content on infants do not address the larger question of whether infant-directed programs have a place in infants' lives, as they do not reflect the reality of commercially-produced infant media (Christakis, 2009).

Infant-directed programs often include educational claims in their packaging and on their websites. However, while the majority of child-directed claims have been empirically justified, most infant-directed claims still need to be evaluated. Further, the few claims that have actually been evaluated seem unsubstantiated. Recent content analyses of infant-directed screen media (Goodrich et al., 2009; Vaala, Barr, Garcia, Salerno, Brey, Pempek, et al., 2009) have indicated that most of infant-directed materials, at least in their current form, are poorly designed and developmentally inappropriate (Linebarger & Vaala, 2010). Goodrich and colleagues (2009) analyzed 59 DVDs designed for children under three. The researchers reported that these infant-directed DVDs contained concentrations of perceptually salient features that were overwhelming – for example: rapid pace, camera cuts, and multiple visual effects, all of which place a heavy cognitive burden on infants' and toddlers' limited processing skills.

The content of these DVDs was generally comparable to child-directed content, which may capture young children's attention and interest but are difficult even for older children to understand. For example, these infant-directed DVDs averaged six cuts per minute. *Blue's Clues*, the educational effectiveness of which has been proven, has three cuts per 30-minute episode (Goodrich et al., 2009). Furthermore, the majority of scenes containing two or more characters lacked good models of adult-child and child-child interaction behaviors (Linebarger & Vaala, 2010). Embedded language support in the infant-directed DVDs consisted mostly of simple labeling, while higher-order language promoting strategies (e.g., questions, audience elicitations, verbal rhyming) were rarely used (Vaala et al., 2009). Researchers need to evaluate further the effects of these features (e.g., salient formal features, language promoting strategies) identified in these studies. Researchers need to determine whether these structural features impact very young children's learning, and if so, how.

Exposure

Recently, the categorization of media content according to the target audience has been applied to distinguish between foreground and background television exposure. Such a distinction also takes into account differing levels of attention to the content. Foreground television exposure happens when infants and toddlers pay active attention to, and interact with, a program that has been designed specifically for their age group,

and is thus at least partially comprehensible; background television exposure, on the other hand, occurs when infants and toddlers are incidentally exposed, and pay little attention to, a program that has not been produced with them in mind, and is thus not comprehensible to them. This way of classifying exposure looks at content from the child's perspective; from the parents' perspective, "background" television may be very much in the foreground.

From early infancy, many children spend a part of their day exposed to screen media. Much of that exposure is incidental: it is the background programming chosen by parents or older siblings. However, as children grow, the amount of foreground television increases. Most previous studies attempting to estimate young children's television exposure made no distinction between foreground and background TV. Instead, these researchers asked parents how much television their children watched during a certain period of time, such as a typical day or week. How parents interpreted this question remains unclear: they might have answered with an estimate of the amount of time their children spent apparently paying attention to a television program in a sustained manner; or they might have included time in which a TV set was in use and children were present, whether or not they were paying attention to the screen. It seems likely that some proportion of parents included background television in their estimates, while others did not. This may lead us to an inaccurate estimate of young children's exposure to screen

media. There are only a few studies that actually make a distinction between background and foreground television.

Parental reports indicate that infants normally began to be exposed to foreground videos at 6.1 months and foreground television at 9.8 months (Linebarger & Walker, 2005; Weber & Singer, 2004). In contrast, their exposure to background television starts as early as three months (Rideout & Hamel, 2006). Most studies that don't specifically assess background TV have found that, on average, children under 3 years old are exposed to television/videos from one to three hours per day (Anderson et al., 1986; Lemish, 1987; Rideout & Hamel, 2006; Rideout et al., 2003; Zimmerman, Christakis, & Meltzoff, 2007). According to more detailed reports, for which children were divided according to age group, the daily exposure to television/videos during a child's first three years rose by approximately an hour per year before finally leveling off: 18% of infants under 12 months of age watched 54 minutes of TV per day; 49% of toddlers between 12 and 23 months watched about 1.5 hours a day; 69% of older children (or preschoolers) ages 24 to 35 months watched over 2 hours a day (Certain & Kahn, 2002; Jordan & Woodard, 2001; Thomspon & Christakis, 2005; Woodard, 2000). This increase in TV/video viewing as the child ages may be a reflection of both a child's growing ability to comprehend program content and the increasing availability of appropriate programs.

There are a few recent studies attempting to differentiate between infant- or child- and adult-oriented programming (Barr, Zack, Garcia, & Muentener, 2008; Courage,

Murphy, Goulding, & Setliff, 2010; Mendelsohn et al., 2008; Pierroutsakos et al., 2004). This differentiation may roughly correspond to the difference between foreground and background exposure. In studies using a 24-hour time diary, parents of infants under 24 months old reported that their children were exposed to an average of 120 minutes of TV each day. Nearly half (49%) of that exposure was to school age/teenage/adult-oriented content (Mendelsohn et al., 2008; Pierroutsakos et al., 2004). Similarly, Barr et al. (2008) assessed 24-hour television/video diaries from homes with infants ages 12, 15, and 18 months. They found that infant-or child-directed programs accounted for about half of the total daily exposure to television/videos (about 1.5 hours out of 3). Additionally, a recent study using parental questionnaires reported that 6-month-old infants viewed about 30 minutes of television per day. By 18 months, infants' viewing had almost doubled, to an average of 72 minutes. About half (13 minutes for 6 months and 27 minutes for 18 months) of their total viewing time was attributable to infant-or child-directed videos (Courage et al., 2010). Consider, however, that Nielson Media reported that the average American home has a TV set in use more than eight hours a day (Gertner, 2005). It seems probable that the actual amount of background television exposure to adult-directed content is much greater than the estimates given by Barr et al. (2008), Courage et al. (2010), Mendelsohn et al. (2008), and Pierroutsakos et al. (2004).

In sum, extant studies have generally indicated that infants and toddlers are exposed to approximately one to two hours of foreground television, along with several

hours of background television, each day. In light of the seemingly enormous amount of exposure to screen media, the cumulative impact on these young children could be substantial. What are screen media's effects on very early development? In the next section, we examine empirical research conducted on infants and toddlers in an effort to estimate the likely developmental repercussions of extensive exposure to screen media.

THE IMPACT OF TELEVISION EXPOSURE

There are only handful of studies with very young children that have examined associations between early television exposure and later developmental outcomes. A few studies have reported deleterious effects of early television exposure on later attention and cognitive skills (Christakis et al., 2004; Lanhuis, Poulton, Welch, & Hoancox, 2007; Schmidt et al., 2009; Zimmerman & Christakis, 2005, 2007). For example, an analysis of data from the National Longitudinal Survey of Youth-Child (NLSY) (1986) has shown that each 1 hour increase in TV viewing before the age of 3 years is associated with modest decreases in Peabody Individual Achievement Test reading recognition (-0.31 points and reading comprehension scores (-0.58) at age 6 years (Zimmerman et al., 2007). Schmidt and her colleagues (2009) also found a negative association between levels of television exposure during infancy and language and visual motor skills at age 3. However, once maternal factors, particularly maternal education, were considered, the relationships between early television exposure and outcomes were no longer present.

Other researchers found no association between early television and later developmental outcomes (Gentzkow & Shapiro, 2008; Mistry, Minkovitz, Strobino, & Borzekowski, 2007; Obel, Henriksen, Dalsgaard, Linnet, Skajaa, Thomsen et al., 2004; Stevens & Mulsow, 2006).

Studies with older children and adolescents have also found a small and negative relation between television viewing and academic achievement (Gortmaker, Salter, Walter & Dietz, 1990; Roberts, Bachen, Hornby, and Hernandez-Ramos, 1984; Williams, Haertel, & Walberg, 1982). Roberts and his colleagues (1984) found that compared to other variables, such as SES and the student's attitudes toward print and television, television viewing accounted for relatively little of the variance in reading achievement among 3rd- and 6th- graders. Others showed that the negative relation between achievement and viewing among adolescents became nonsignificant when geographical and demographic variables were controlled (Gortmaker et al., 1990).

In truth, these inconsistent results indicate that the relation between television viewing and achievement may be curvilinear. Williams, et al., (1982) reported a meta-analysis of 23 large-scale studies showing that children who watched 10 hours a week performed slightly better than those who watched less. As viewing increased beyond 10 hours a week, however, achievement declined dramatically. Other investigations suggest that the greatest differences in academic skills lie between children who watch moderate amounts of television and those who are excessive viewers. In one investigation

(Neuman, 1991), children who watched up to 25 hours of television per week had high skill levels, whereas those who watched more than 4 hours daily had low skill levels. Reading scores were highest among children who read every day *and* viewed 2 to 4 hours of television, and lowest among those who rarely read or watched television. Others found that the negative relations between academic skills and content viewed were strongest among those who watched 30 or more hours of television a week, and that the genres that contributed most to the negative relationship were cartoons, sports, and MTV (Potter, 1987). However, there is no comparable study with infants and toddlers, investigating the curvilinear relation between differing levels of television exposure and achievement. Moreover, variations in the specific kinds of program content to which children are exposed may partly explain existing findings.

A substantial body of literature (e.g., Anderson et al., 2001; Huston, Anderson, Wright, Linebarger, & Schmitt, 2001) has documented adverse effects of age-inappropriate, non-educational programs on later outcomes of preschool and school-aged children, including cognition, achievement and behavior. Emerging research also strongly suggests the potential for adverse effects of adult-directed background television beginning in infancy (Barr et al., 2010; Tomopoulos et al, 2010; Zimmerman et al, 2007). Barr and colleagues (2010) found that high levels of exposure to adult-directed television at ages one and four were associated with parental reports of their children's poorer executive functioning and poorer cognitive outcomes at age four. Tomopoulos and her

colleagues (2010) also reported that exposure to older child/adult-oriented programs at age 6 months was related to lower cognitive and language development at age 14 months. Similarly, Zimmerman and Christakis (2007) reported that early childhood exposure to higher levels of age-inappropriate, non-educational, and violent programs, which contain a large number of perceptually salient formal features, was associated with parental reports of attention problems in 7-year-olds. These three studies substantiated the existence of a negative link between early exposure to adult-directed background television and subsequent cognitive outcomes.

On the other hand, these same studies (Barr et al., 2010; Tomopoupos, 2010; Zimmerman et al, 2007) did not find any relationships between early exposure to educational programs and later cognitive outcomes or later attention problems. It should be noted that due to the correlational nature of the studies, causal links and the direction of the relation between early media exposure and later cognitive skills cannot be established. Nevertheless, these three studies confirm that screen media content may be an important factor in understanding the relation between media exposure and developmental outcomes. They also demonstrate that there is a negative relationship between background television and developmental outcomes.

Other research indicates that content is also crucial in terms of associations with language development. In a longitudinal study of 6- to 30-month-olds, Linebarger and Walker (2005) found that certain television shows (*Blue's Clues* and *Dora the Explorer*)

were associated with greater language production, whereas others (*Barney* and *Teletubbies*) were negatively related to vocabulary acquisition. Furthermore, smaller receptive vocabulary was associated with viewing more than one hour per day of infant-directed videos, such as the *Baby Einstein* or *Brainy Baby* series (Zimmerman, Christakis, and Meltzoff, 2007). The long-term effects of exposure to infant-directed programing remain unknown.

What is the mechanism behind the negative relationship observed between early exposure to background television and subsequent cognitive outcomes? Several studies have proposed that young children's exposure to adult-directed background television has a negative impact on subsequent cognitive development through two mechanisms: reduced sustained attention during toy play and lower quality of parent-child interactions (Christakis et al., 2009; Kirkorian et al., 2009; Schmidt et al., 2008). Suppose, for example, that a boy is playing with toys or is engaging in a social interaction while an adult television program is on in the background. The TV may interfere with his staying focused. Perceptually salient stimuli – say the sound of a car crash or a gunshot – may produce in the child a reflexive orienting response. However, since the content is incomprehensible to him, his attention wanders (Schmitt, 2001). Over time, such repeated interruptions of children's ongoing activities may interfere with the early development of attention regulation (Barr et al., 2010).

This supposition is supported by a study reporting that when young children are interrupted during play, they have difficulty returning to the play episode. If they do, it is typically with less intensity (DiLalla & Watson, 1988). Thus, to the extent that television disrupts children's play, it may have a negative impact. Research on parent-child interaction also suggests that the complexity of a child's play increases with parental support (Alessandri, 1992). Thus, the extent to which television draws parental attention away from the child may reduce the number and effectiveness of parent-child interactions, thereby causing both direct and indirect negative effects of background television on the child.

There are a few studies that directly examine the impact of background television on very young children's play and on parent-child interactions (Christakis et al., 2009; Kirkorian et al., 2009; Schmidt et al., 2008). Schmidt and colleagues (2008) observed one-, two-, and three-year-olds playing with toys in a laboratory setting. They reported that when the TV was on, children's play episodes were neither as long nor as complex or focused as they were when it was off. Kirkorian and colleagues (2009) subsequently conducted the same experiment, except that they asked parents to interact with their children. When the adult television program (*Jeopardy!*) was on, parents engaged in significantly less toy play, and were less actively involved with their young children. In a cross-sectional study, Christakis et al. (2009) reported a similar result: in their study, the

number of conversational turns between an infant and his or her parent significantly declined when the TV was on.

Together, these studies confirm that chronic exposure to adult-directed background television, via the mechanisms of fewer parent-child interactions, less focused attention during play, and reduced play episode length, could be an environmental risk factor in infants' and toddlers' development.

HOW DO YOUNG CHILDREN LEARN FROM MEDIA PRESENTATION

The first three years of life mark a period of particularly rapid change in all of the neural, sensory, and perceptual systems that underlie children's emerging cognitive abilities. One implication of this rapid development is that the viewing experience and viewing consequences for infants and toddlers would not be the same as they are for preschoolers and older children. Especially, it appears that for children younger than 2 years of age, screen media (mainly TV and videos/DVDs) may have a different impact than they do for older children (Anderson & Pempek, 2005; Courage & Howe, 2010). According to Piaget, children younger than two years have been widely characterized as functioning in a sensorimotor manner, with their symbolic understanding quite limited (Piaget, 1969). It may be that television in its present form is difficult for children younger than two to comprehend because it is not until late in the second year of life (until the beginning of pre-operational stage) that children fully develop understanding of

dual representation (DeLoache, 2000). There are other possibilities than a lack of symbolic awareness, including immature perceptual, linguistic, attentional and other cognitive skills which limit what children younger than two can learn from screen media exposure (e.g., Courage & Howe, 2010; Valkenburg & Vroone, 2004). Whatever the case, after two years old, understanding of television appears to improve significantly, and the evidence for a positive impact of educational television becomes clear (Anderson et al., 2001; Rice, Huston, Truglio & Wright, 1990; Wright et al., 2001).

Piaget's Cognitive Developmental Theory

Researchers have applied Piaget's theory widely in their studies on television and children's cognitive development. According to Piaget, all knowledge comes from action. That is, children actively acquire knowledge through interaction with their physical environment (Flavell, 1963; Piaget, 1969). The infant comes to know a rattle by shaking and mouthing it; the preschooler gains knowledge by interacting with peers. By acting on the environment, moreover, children move through four invariant and universal stages. These begin at birth and continue through adolescence. The stages are the sensory-motor stage, the pre-operational stage, the concrete operational stage, and the formal operational stage. Only the two earlier stages, which occur during infancy and toddlerhood, will be reviewed here.

During her first two years, the infant passes through the sensory-motor stage. Mental schemas are shaped by her senses and actions. Her cognitive growth and learning come from what she sees, hears, smells, tastes, senses, touches and reaches for. If we apply Piaget's theory to screen media, we note that a child may learn about the unique world of television by touching the screen when her favorite puppet appears, by clapping her hands to music, or by playing with the power button. These sensory-motor experiences are gradually integrated into the child's developing understanding of television and social reality. The child can thus understand that puppets on television feel different than the stuffed animal in her crib (Lemish, 2007).

The pre-operational stage (between ages two and seven) is characterized mainly by the acquisition of language, which frees children from the sensory-motor limitations of the "here and now." It allows for the development of representational thinking skills, which enable children to talk about their experiences. In this developmental stage, children are not so bound by action anymore. They are more occupied with knowledge, information, and socially shared symbolic systems such as language. This capacity for representation manifests itself also through symbolic play and deferred imitation, both of which play a large role in the transition from the sensory-motor to the pre-operational stage of cognitive development.

Each stage is characterized by the development of different mental structures called "schemas". Schemas change through the complementary processes of assimilation

and accommodation. In assimilation, the child interprets the environment in terms of his present way of thinking. In accommodation, the child changes and expands on what he already knows. When the child encounters something in the environment that he does not understand, he must expand, through accommodation, his view of the world. Doing so restores equilibrium (Zigler & Bishop-Josef, 2004). These assimilation and accommodation processes undoubtedly also contribute to children's understanding of television content: children assimilate comprehensible television knowledge using existing mental skills, and accommodate them by refining those skills using knowledge newly acquired by watching TV.

One form of accommodation is imitation. Here, children minimize their interpretations and simply mimic what they see. The most significant event in the sequence of development, in terms of accommodation, is the emergence of deferred imitation. Deferred imitation occurs during the later sensory-motor stage, somewhere between 18 and 24 months. This event signals an infant's ability to recall a model's behavior following a delay. Up to this point, children are thought to be incapable of representing information mentally or internally. Therefore, in light of Piaget's ideas, learning from television may be difficult for children under two. TV is a symbolic medium; as such, it requires children to be capable of mental representation before they can understand it. Such a medium, which offers images that don't always conform to the laws of time and space, is more cognitively demanding than physical reality. Young

children, who lack an understanding of some of the basic properties of reality, such as the solid nature of objects and the continuity of objects over time (objects don't just disappear), may be even more confused when faced with some of the object manipulations that occur on a television screen.

Evidence suggests, however, that children may be more competent than Piaget assumed. In a series of laboratory studies, Meltzoff and colleagues detected some ability to defer imitation from a live model over a 24-hour period in infants as young as nine months; more typically, though, these abilities occur at 14-15 months (Meltzoff, 1988; Meltzoff & Moore, 1998). Moreover, a recent study reported that infants as young as six months successfully deferred imitation tasks when the televised presentation was repeated six times (Barr, Muentener, & Garcia, 2007). Meltzoff's and Barr's studies are among many that have raised the more general question of whether infants may be capable of some forms of internal representation at an earlier age than Piaget had believed. These studies suggest that even children in the sensory-motor stage can learn from what they observe on television, even though most of their learning still comes from their direct sensory experiences.

Attention and Comprehension

To learn by watching television, a child must pay some attention to what is happening on the screen (Calvert, Huston, Watkins, & Wright, 1982). As we reviewed

above, infants were engaged in secondary activities for almost half of their viewing time (Schmitt, Woof & Anderson, 2003) and, therefore, they paid relatively little attention to television; however, as they matured and gained experience with the medium, their attention gradually increased (Anderson & Levin, 1976; Schmitt, 2001). In a laboratory study, Anderson and Levin (1976) found a linear increase in the attention children of different ages paid to a child-targeted program (*Sesame Street*): they paid attention around 10% of the time at age one, but this increased to more than 50% of the time at age four (Anderson & Levin, 1976). Schmitt (2001) reported a similar increase in time spent attending to the TV, from about 11% in 6-month-olds to about 39% in 3-year-olds.

These estimates of viewing time will likely increase for infants and toddlers as their exposure to programs that target their level of comprehension become more readily available (Anderson & Loch, 1983). Consistent with this notion, recent studies suggest that infants and toddlers are very attracted to at least some infant-directed videos (Barr et al., 2008; Barr et al., 2010). Barr et al. (2008) found that 12- and 18-month-olds were highly attentive to infant-targeted programs (e.g., *Baby Einstein*), though their attention varied from 48 to 74 percent. Such programs elicited high levels of sustained attention especially when children were familiar with the content, when they were exposed to the program repeatedly, and when their parents interacted with them while they watched (Barr et al., 2007a; Barr, Muentener, Garcia, Fujimoto & Chavez, 2007b; Barr et al., 2008; Barr et al., 2010).

There are developmental differences not only in the amount of time spent looking at the screen, but also in what captures attention. Home observations of infants and toddlers, as well as reports from parents, indicate that very young children pay attention to different formal features of programs depending on their developmental age (Lemish, 1987, 2007; Weber & Singer, 2004). Infants under 6 months attended to loud voices and sudden noises on television. Infants between 6 and 10 months old were attracted to specific sounds, such as drumming, a character's voice, laughter, and howling wolves. Ten- to eighteen-month-olds' patterns of attention focused on music, content (especially simple stories), and character awareness. Toddlers 18 months and older focused their attention on commercials and programs that included vivid music, number and letter sequences, and human conversation. By the end of their second year, children's viewing periods extended, with signs of growing interest in the animation genre. At 30 months old, children were able and willing to pay attention for a full half hour or longer (Lemish, 1987, 2007).

These developmental changes in attention can be explained by the feature signal model (Huston & Wright, 1983, 1989). In this comprehensive model of attention to television, the attention of a very young, inexperienced viewer is organized around salient formal features such as rapid action, sound and visual effects, and rapid cuts; slightly older, slightly more experienced viewers, on the other hand, control their attention and allocate it to the television screen when something interesting and comprehensible is

happening. In accordance with the feature signal model, several studies have confirmed that infants' and toddlers' attention to televised content increases and remains high in the presence of perceptually salient features such as lively music, characters' voice (female and child), and sound effects, but decreases as the length of an episode increases, during low action, and during periods of adult narration (e.g., Anderson & Levin, 1976; Calvert, et al., 1982; Valkenburg & Vroone, 2004).

These developmental differences in attention to formal features were also supported by research by Valkenburg and Vroone (2004). In a naturalistic home observation study, children aged 6 to 58 months old were shown a video composed of six brief television segments of varying degrees of complexity (the news, *Sesame Street, Teletubbies, Lion King II* and commercials aimed at children and adults) in their homes. They found that children between the ages of 6 and 18 months predominantly attended to salient formal features, such as applause, laugher, peculiar sounds, rapid character action, and visual surprise; children between the ages of 18 and 30 months began to rely less on salient formal features of television (e.g., music, bright colors) and more on non-salient features and content (e.g., letters, numbers, and meaningful dialogue) (Valkenburg & Vroone, 2004). These results suggest that, by 18 months, children's experience of screen media is more than a primitive orienting response to visual and auditory elements on the screen (the formal features of the content), and that it may be guided by higher-level cognitive skills dependent on the comprehensibility of the program.

The stimulus sampling model has also suggested that formal features that signal interesting or comprehensible content, independent of the actual content, would guide children's attention. This has received empirical support in a study by Campbell and colleagues (1987) of 120 Kindergarteners, in which the program format (child-oriented vs. adult-oriented) of educational messages was varied experimentally; the child-oriented versions used animated characters, and animated voices with sprightly music, whereas the adult-oriented versions used real-life characters and an adult male voice to convey the information with sedate background music. The child-oriented versions elicited significantly more attention than the adult-oriented versions; free and cued recall scores were also higher for child- than for adult-oriented versions (Campbell et al., 1987).

A similar result with children aged 6 to 58 months old has been reported by Valkenburg and Vroone (2004). In their study, across all age groups, the opening scenes signaling adult-oriented content (i.e., the news and commercials targeting adults) led to sharp decreases in attention, which was maintained in the scenes afterwards. On the other hand, the opening scenes signaling child-oriented content (i.e., *Teletubbies*) led to increases in attention in all age groups. However, the more difficult child-oriented opening scenes (i.e., *Lion King II* and the children's commercials) including similar salient features didn't get attention from the youngest group (6-18 months). These results show that even infants as young as 6 months old can use program features to allocate

their attention to television content that is potentially interesting to them and to avoid content that is too complex, adult-oriented, or uninteresting to them.

There is evidence that the transition of attention control from auditory-visual saliency to comprehension may occur around 18 months (Anderson & Lorch, 1983; Pempek, Kirkorian, Stevens, Richards & Anderson, 2008; Richards & Cronise, 2000; Valkenburg & Vroone, 2004). In one laboratory study that measured children's attention to one normal and three distorted versions of *Teletubbies,* toddlers aged 18 and 24 months looked longer at the normal version than the distorted ones; infants aged 6 and 12 months on the other hand, didn't show any differences in their viewing patterns, no matter which version they were shown (Pempek et al., 2008). Richards and Cronise (2000) found a similar pattern of results when they compared heart rate and visual orienting in response to *Sesame Street* as opposed to computer-generated kaleidoscopic shapes and sounds. Consistent with these results, a recent eye-tracking study of television viewing across a broad age range reported that 12-month-olds were highly variable in their looking at a 20-min excerpt from *Sesame Street*, while older children and adults were much more consistent in where they looked during each frame of the program (Kirkorian, 2007). This finding suggests that, sometime after 1 year, infants learn when and where to look on the screen in order to efficiently comprehend television. Altogether, these studies imply that by 18 months of age (and perhaps earlier), infants' attention to

the screen is at least partly guided by comprehension of the material, whereas younger infants' attention is likely guided primarily by salient perceptual content.

Taken together, this evidence suggests that very young children's visual attention to television may be driven by mechanisms that differ from those that matter to older children and adults. This developmental shift, in which attention driven by auditory-visual saliency gives way to attention that depends on comprehension, occurs gradually over the course of infancy and toddlerhood. This transition is especially noticeable between 18 and 24 months, the period that Piaget calls the last stage of sensory-motor development. It is due, in part, to changes in cognitive control, and may also reflect an increasing ability to understand content and symbolic representations in screen media. Although the link between comprehension and attention has clearly been established for preschool children, more research is necessary to establish such a link for infants, especially those younger than 18 months. This missing information is of critical importance if we wish to develop a comprehensive theory of children's attention to television.

The Video Deficit

Even if programming is foreground television, infants may learn significantly less from a video demonstration than from a live demonstration. This disparity is known as the "video deficit effect." Many researchers have continued to question whether children

under three years old can actually learn from the screen; their skepticism is based on evidence demonstrating the existence of the video deficit. The video deficit effect has been found in studies of imitation (e.g., Barr & Hayne, 1999), object search tasks (e.g., Troseth & DeLoache, 1998) and language-based tasks (e.g., Kuhl, Tsao, & Liu, 2003).

In a series of studies using deferred imitation paradigms that were based on Bandura's (1965) observational learning and Piaget's (1969) theoretical conceptualization of symbolic representation, video presentations were found to be less effective than live presentations. Researchers (Barr, & Hayne, 1999; Barr et al., 2007a; Barr et al., 2007b; Hayne Herbert, & Simcock, 2003; Strouse & Troseth, 2008) observed two groups of 12- to 30-month-olds. Both groups watched an adult do a sequence of steps with a toy, but the first group watched a video and the second group viewed the action live. The first group consistently exhibited less deferred imitation. By about age three, this phenomenon disappears (McCall, Parke, Kavanough, Engstrom, Russell & Wycoff, 1977).

There may be significant task-related and age-related differences in young children's abilities to demonstrate actions performed in the video context (Barr & Hayne, 1999; Barr et al., 2007a; Meltzoff, 1988). When the task was simplified and infants were tested immediately, among 14- and 15-month-old children, imitation of an action occurred equally well whether that action was presented live or on video (Barr & Hayne, 1999; Meltzoff, 1988). In a subsequent study examining whether multiple exposures to a video task improved imitation, infants as young as six months, watching a video or a live

model, successfully completed a 24-hour delayed imitation when the demonstrations were performed six times (Barr et al., 2007a). Children aged 12 and 15 months old watching a video model failed the imitation task when target actions were repeated three times. Doubling this exposure ameliorated the video deficit for 12-month-olds but not for 15-month-olds (Barr et al., 2007a). These results suggests that the video deficit may not exist initially, at least when it comes to imitating simple tasks, but rather emerges at approximately fifteen months of age.

Object retrieval task studies fall into line with imitation studies. However, imitation is a fairly simple process compared to complex object-retrieval tasks, because in order to succeed at object retrieval tasks, the child needs to develop a representation of the hiding event, which is held in memory (e.g., watching a toy being hidden on TV) and behaviorally implemented during the task (e.g., finding the toy in an adjacent room). Using this object retrieval paradigm, researchers found that 30-month-olds, but not 24-month-olds, could retrieve the toy when they saw it hidden on video; children improved their performance with age (Schmitt & Anderson, 2002; Troseth et al., 1998). These studies indicated that not until children were three did they perform equally well in both conditions.

Studies on language learning have also supported the video deficit hypothesis. Although there is evidence that children two and over can evidently learn vocabulary from television (Naigles & Kako, 1993; Rice et al., 1990; Rice & Woodsmall, 1988),

several recent studies have shown that children younger than 2 years learn better in live conditions (Krcmar et al., 2007; Kuhl et al., 2003). Krcmar et al. (2007) also investigated the ability of toddlers aged 15 to 24 months to learn novel words from television in the laboratory setting. They found that only half as many older toddlers (those between 22 and 24 months of age) were as able to learn a new word from the person on video as from the live speaker. In another study, Kuhl et al. (2003) reported that when it comes to preserving discrimination of foreign phonemes, video models are less effective than live ones during the first year of life. These studies clearly show that the video deficit is exhibited by older infants and toddlers across different experimental paradigms, such as imitation tasks, object retrieval tasks, and language learning tasks.

Researchers have begun to search for an answer to the question, "Why is the video deficit happening in infancy and toddlerhood?" Studies indicate that a variety of perceptual, cognitive, and social immaturities make learning from video difficult for infants and toddlers. These difficulties stem from two sources: the combined effects of impoverished perceptual encoding of information from two-dimensional (2D) sources (Schmitt, 1997) and children's difficulty in perceiving the duality of the relationship between a symbol and its referent (Pierroutsakos & Troseth, 2003; Troseth & DeLoache, 1998). Additionally, there is evidence that that toddlers' everyday experiences with TV and video make them think that these media are not interactive, that they are neither real nor directed at them personally, and thus that they are useless in the real world (Troseth,

Saylor, & Archer, 2006; Troseth & DeLoache, 1998). It seems as if toddlers learn more when they think what they see is live action. In one study, for example, researchers placed a monitor behind a window, making 24-month-old toddlers believe that they were watching a live presentation. The toddlers more often used the information from this TV than from a regular one (Troseth & DeLoache, 1998, Experiment 3). In contrast, when a video presentation was made more like television, children were less likely to use the video for information (Schmitt & Anderson, 2002). This is consistent with studies reporting that 2-year-old toddlers' personal experiences with the screen (e.g., children observing themselves on their parents' camcorder screens and on security monitors in stores) are positively related to children's successful use of television images as information in object retrieval task (Troseth, 2003b; Troseth, Casey, Lawver, & Cole, 2007). These results confirm that children's failures to learn from video involve their early, incomplete conceptual understanding of the nature of video images, abstracted from their prior experiences with television.

Furthermore, several studies report that after 24-month-olds succeeded at using information from televised images on a first trial of the video search task, they actually failed the subsequent tasks because they generally searched for the object where it had been hidden the first time (that is, they made perseverative errors); in contrast, their counterparts, who watched live performances, improved their performance over successive trials (Deocampo & Hudson, 2005; Schmidt, Crawley-Davis, & Anderson,

2007; Troseth, 2003a; Troseth et al., 2006). This superior first trial performance by toddlers watching video implies that young children can retrieve memories of objects and events from TV, at least on the first trial, but that any additional information processing from TV seems to be overwhelmed by the prior experience from the first trial.

Paradoxically, infants one year old or younger (i.e. as young as 6 months), who have less experience with television and fewer expectations about it, sometimes accept what they see on video at face value and are less likely to show a video deficit, treating the 2D video and the 3D live demonstrations alike (Barr et al., 2007a). Over time, as young children gain sufficient experience with a range of symbols, they begin to understand their representational power. They begin to relate these symbols to the real world in an adult-like way (Troseth & DeLoache, 1998). This process occurs gradually, and it is not until they are nearly 3 years old that children come to perceive information from the screen as meaningful. The video deficit effect disappears at that stage.

THEORIES OF SCREEN MEDIA EFFECTS

If television does affect very young children's intellectual development, little is known about the processes involved. To guide the present investigation, I have attempted to summarize the predictions from some major theories and hypotheses about media effects.

Social Cognitive Theory

Social cognitive theory, originally termed social learning theory, proposed by Bandura (1965), provides another framework for understanding the ways in which children learn from screen media. According to Bandura, models influence children mainly by providing information rather than by eliciting matching behavior. Thus, in observational learning, a child can learn without performing a model's behavior even once. Overt behavior, while important, is only one aspect of learning. There is even evidence that for children, observational learning can be more effective than learning by direct participation. Watching another person solve a problem may provide a better overall idea of the nature of the problem than being thoroughly immersed in it oneself (Miller, 1989).

In the case of television, imitative processes in which infants and toddlers see another person depict a behavior and then copy it, adding it to their own behavioral repertoire, occur through processes of social learning that take place via observation of models on the screen. The earliest studies of media aggression shed light on the process of observation in young children and the subsequent imitation of aggressive behaviors. In a classic experimental study (Bandura, Ross, & Ross, 1963), preschool children watched as an adult, using an inflatable clown, modeled a number of novel aggressive acts. When, immediately following, the children were allowed to play with the clown, those children exposed to the adult model exhibited high levels of aggressive behavior toward the

clown. Furthermore, children were as likely to imitate aggressive acts modeled on television as they were to imitate the same behavior modeled live (Bandura et al., 1963). In a similar laboratory study (Bandura, 1965), three- to five-year-old children were exposed to a film in which a model that had acted violently was rewarded, punished, or received no consequences. After viewing, children, particularly boys, who had seen the model rewarded for aggressive behavior were more likely to imitate the aggressive behaviors spontaneously than were those who had seen the model punished. However, when children were offered incentives to reproduce the aggressive behavior, most could do so. In other words, there was a difference between what the children learned and the actions they performed. Bandura (1965) concluded that children had learned the aggressive action by observation, and even if they didn't spontaneously imitate it then, they had stored that information for possible later use.

There is substantial evidence for early learning from television through observation by infants and toddlers in their home environment or in laboratory settings, including deferred imitation (Lemish, 1987; Meltzoff, 1988) and language learning (Krcmar et al., 2007; Lemish, 1987). Meltzoff (1988), for example, found that 14-month-olds could later imitate video-taped events that they had observed on a television monitor, such as manipulating a toy in a specific manner. In a home observation study, Lemish and Rice (1987) have found that infants as young as twelve months labeled objects and actions that they saw on television. Krcmar et al. (2007) also reported that

children 22 to 24 months old could learn a novel word from television segment (i.e., *Teletubbies*) in a laboratory setting. These studies suggest that imitation is not only an important general skill developed in infancy and toddlerhood, but is also the initial mechanism that allows children to understand televised and video models.

Vygotsky's Social-Cultural Theory

Vygotsky's social-cultural theory underscores the central role that parents play in infancy and toddlerhood. It provides yet another valuable framework for comprehending children's learning from television. Vygotsky (1978) emphasized that interactions with others lead to internalization of cognitive processes that were first achieved only in the social context. Through social interaction, the more advanced or expert partner (e.g., the mother) raises the level of performance of the less advanced partner (e.g., the infant or toddler) (Rogoff, Mistry, Goncu, & Mosier, 1993). The difference between children's spontaneous performance of a task without guidance, and that observed with guidance, represents a central cognitive concept in Vygotskian theory known as the zone of proximal development (ZPD) (Lamb, Bornstein, & Teti, 2002).

Vygotsky's idea of the ZPD centers on problem solving under adult guidance. Very young children's experiences stem directly from interactions they have within the family. Adult caregiving figures take principal responsibility for structuring most, if not all, of the infants' early experiences(Lamb et al., 2002). Sensitive parents tailor their

scaffolding behaviors to match their infants' and toddlers' developmental progress -- for example, by providing more learning experiences (Rochat, Querido, & Striano, 1999).

Considering the fact that processing of information from television is cognitively challenging for infants and toddlers, the role of parental scaffolding in children's ability to learn from media may be particularly crucial. There are, to date, few descriptive studies that directly examine parent-child interactions during television viewing. Lemish and Rice (1984) observed children aged six months to two-and-a-half years over a six-month period. The authors reported that an infant's viewing with a parent increased the infant's responsiveness. Responsiveness took the form of pointing and imitating, and was especially noticeable when co-viewing was accompanied by mediation (e.g., actively drawing attention to important aspects of the program, high levels of labeling and descriptions of content). Studies with older children produced similar results (Valkenburg, Krcmar, & deRoos, 1998).

Whatever the effects of parental style on screen viewing time and infant responsiveness might be, research suggests that scaffolding by parents might be particularly helpful during infancy. It can enable the infant to link televised information to what she sees in the real world. Consistent with Vygotskian theory, several studies with infants and toddlers have reported that parental scaffolding during television co-viewing positively impacts attention to and learning from television (Barr et al., 2008; Demers, 2008; Lemish & Rice, 1984). Demers (2008), for example, found that 12- and

18-month-old infants were more likely to look at the TV if their parent looked, and they were also more likely to look away if the parent looked away. That is, parents facilitated their children looking at television by their own looking behavior, possibly providing an implicit (and unintentional) form of instruction about when to pay attention to the television. Furthermore, parents who scaffolded their children's viewing by questioning, labeling or describing objects on screen had children who attended better and interacted more with the television program (Barr et al., 2008). These verbal behaviors engaged in by the caregiver (or narrator) direct children to important aspects of the program and help them process the video stimuli. These results are consistent with evidence of enhanced learning for preschoolers when parents co-viewed with children, or when onscreen characters used similar co-viewing learning strategies within the program (e.g., questions, personalized interactions, and reflections) (Watkins, Calvert, Huston-Stein & Wright, 1980). Though these studies did not evaluate how much was learned directly from the video, there is evidence from studies of storybook reading that greater attention to the material during parent-child interaction facilitates learning from it (DeLoache & Chiong, 2009).

Together, these studies suggest that parental co-viewing functions as a scaffold for children's comprehension, retention, and later transfer of information learned while viewing.

Mental Effort Hypothesis (The Amount of Invested Mental Effort, AIME)

According to the mental effort hypothesis, general- or adult-directed television programs do not engage the young child's mental effort. The most common version of this hypothesis is that entertainment television makes few intellectual demands and, as a result, creates habits of intellectual laziness and disinterest in school (Beentjes & van de Voort, 1993; Koolstra & van de Voort, 1996; Salomon, 1984). Some support for this hypothesis appeared in a longitudinal study of second- through eighth-grade Dutch children, which found that television viewing was associated with a subsequent decrease in positive attitudes toward reading. Attitudes toward reading, in turn, predicted reading achievement and time spent reading (Koolstra & van de Voort, 1996). But for very young children, much of general- or adult-audience television may be difficult rather than easy to comprehend. Children are most likely to become actively engaged with television content that is neither too easy nor too difficult to comprehend – that is, content that provides some challenge, but also allows an attentive child to gain a sense of mastery (Rice, Huston, & Wright, 1982; Wright et al., 2001). An infants or a toddler who spends a lot of time in the presence of general- or adult-directed television that is not comprehensible may miss such opportunities, which then results in lower level of academic performance.

Displacement Hypothesis

The displacement hypothesis has been proposed by many theorists and critics to explain the longitudinal effects of early television exposure on academic achievement. A simple displacement hypothesis predicts that time spent viewing TV will be negatively correlated with time spent engaged in developmentally important activities (e.g., play, spending time with parents, social interactions, and acquiring literacy skills), resulting in lowered levels of intellectual functioning and academic achievement (Healy, 1990; Wright et al, 2001). This happens, according to the hypothesis, because television is highly attractive to children, presumably more so than participation in other activities. According to this view, television not only displaces concurrent activities and learning opportunities, but extensive early experience with television can also lead to enduring habits of time use that are both intellectually and physically passive. Turning on the television becomes a habit to relieve boredom, reducing the likelihood that children will find more involving, active pursuits. Not surprisingly, displacement theory predicts generally negative effects of television viewing, especially with respect to cognitive development and academic achievement.

This displacement notion, however, may be too simplistic to be applied to infants and toddlers. In a recent study, for example, Vandewater, Bickham, and Lee (2006) found that amount of viewing time was not associated with less time spent in being read to or in less active play in toddlers, although it was associated with less creative play. Clearly, the

relation between television viewing and other activities does not follow a simple displacement hypothesis in which time spent viewing means less time spent on other activities (Huston, Wright, Marquis, & Green, 1999).

Moreover, evidence shows us that infants and toddlers' viewing behaviors are not similar to those of older children and adults, because these younger children tend to remain active in front of TV; they tend to engage in social interaction with others (mostly parents and siblings) and play during times in which they are being exposed to TV (Lemish, 1987; Schmitt, 2001; Schmitt, Woolf, & Anderson, 2003; Weber & Singer, 2004). A study based on in-home television viewing patterns in five age groups (2-, 5-, 8- and 12-year-olds, and adults) indicates that older children's and adults' physical activity levels were low when a TV was on; two-year-olds, in contrast, showed a substantial amount of physically active behavior. Nearly half of 2 year olds' viewing time was spent with their siblings and parents, and more than 39% of their viewing time was spent playing; both of these active viewing behaviors declined with age (Schmitt et al., 2003).

In a more detailed analysis, Schmitt (2001) found that 2- to 3-year-olds were physically active for about a third of their time in the viewing room. Their most frequent activities while watching television programs were interacting with siblings or parents (39.2%) and playing (32.1%). Talking was the most common type of social interaction, followed by looking at others, sitting beside another person or cuddling. In terms of play behaviors, playing with toys was most common, followed by diffuse play such as running

around the room, rolling on the floor, or kicking legs in the air. All such activities were physically active without being structured or organized. Toddlers spent very little of their viewing time eating (7.6%) or reading (2.2%), but these activities became more common at older ages. Other studies have also shown that infants and toddlers engage in some kinds of age-appropriate activities even when the television is on or a video is playing (Lemish 1987; Weber & Singer, 2004). These studies suggest that, at least for young children, TV may not interfere with play, and TV and play may not be alternative and mutually exclusive ways to spend time.

Although television viewing in general does not clearly displace valuable activities, it is possible that the content to which children are exposed may be important with respect to displacement of developmentally important activities. In a three-year longitudinal study of 2- to 7-year-olds, Huston and her colleagues (1999) examined the relations between television use and other childhood activities. They recognized the possibility that children's free time activities may be related to what they watch on television as well as to how much they watch. Over the three years of the study, they collected extensive data on children aged from 2 to 5 (in cohort 1) and from 4 to 7 (in cohort 2). Children's television viewing, including the titles of programs watched and other activities engaged in, were measured using up to 18 individual 24-hour time-use diaries that were collected throughout the span of the study. The researchers found that as viewing of general entertainment programming increased, children spent less time in

reading and educational activities, social and outdoor activities, and video game play; conversely, declines in viewing were associated with increases in other activities. There was no relation, however, between changes in time spent viewing child-educational programs and time spent in other activities. These results suggest that if a negative impact of time displacement exists, it is associated with the time spent viewing general entertainment content rather than child-educational content. Time displacement thus has a plausible but unproven impact on cognitive development and academic achievement.

For very young children, as we reviewed above in discussing the impact of background television exposure to adult-directed content, general- or adult-audience programming may displace or interfere with the child's opportunities to spend time with parents, thus decreasing the amount of parental interaction (which is critical for cognitive and socio-emotional development) with infants and toddlers. Infants and toddlers are usually exposed to general- or adult-audience programs in the company of parents or other adults (St. Peters, Fitch, Huston, Wright, & Eakins, 1991). Adults watching television may be unresponsive and inattentive to their children. As a result, children may have fewer social and linguistic interactions with adults (Christakis et al., 2009); meanwhile, they are deriving little from the television content that is occupying the adults' attention.

Summary. Observation learning, proposed by social cognitive theory, is one likely mechanism by which children learn from the planned messages in child-educational

programs as well as the unplanned messages that occur in many other types of programming. Child-educational programs such as *Sesame Street* and *Mister Rogers' Neighborhood* have planned, age-specific curricula, and they contain linguistic and production techniques designed to enhance learning (Huston & Wright, 1998; Rice, 1984); adult/noneducational programs, on the other hand, contain language and humor that are beyond the comprehension abilities of infants and toddlers, as wells as high levels of violence. Vygotsky's social-cultural theory would predict that parental co-viewing of child-educational content should enhance the effects child-educational content has on children's academic achievement. Finally, mental effort hypothesis and displacement hypothesis have been proposed to account for predicted negative influences of adult/noneducational television on intellectual development.

RESEARCH QUESTIONS AND HYPOTHESES

Given these empirically-based statements, the following hypotheses can be drawn:

Research Question 1

How much are infants and toddlers exposed to television? What are these children exposed to? How much do infants and toddlers co-view with their parents? What do they

co-view with their parents? What are the secondary activities that occur alongside television viewing?

Research Question 2

How does early television exposure in infancy and toddlerhood influence cognitive outcomes in childhood?

Hypothesis 2-1. Total amount of television exposure in infancy and toddlerhood will be negatively related to academic achievement performance (i.e., the letter-word recognition test scores, the passage comprehension test scores, and applied problem test scores).

Hypothesis 2-2. The associations between television exposure and academic achievement performance (i.e., the letter-word recognition test scores, the passage comprehension test scores, and applied problem test scores) will vary depending on content, with the greatest adverse effects seen for adult content and the greatest positive effects seen for child-educational content.

Research Question 3

How does the parental co-viewing in infancy and toddlerhood influence cognitive outcomes in childhood?

Hypothesis 3. The associations between parental co-viewing and children's academic achievement performance will vary depending on content, with the greatest positive effects occurring for parental co-viewing of child-educational content. In particular, parental co-viewing of child-educational programs will be positively related to reading and math skills (i.e., the letter-word recognition test scores, the passage comprehension test scores, and applied problem test scores).

Chapter 3: Method

DESCRIPTION OF SAMPLES

The PSID-CDS Sample and Subsample

The data for this study came from the first and second waves of the Panel Study of Income Dynamics (PSID) Child Development Supplement (CDS-I and CDS-II). Since 1968, the PSID has focused primarily on the transfer of social and economic capital within families; it is an ongoing, nationally representative panel study. In 1997 (CDS-I, Time 1), the PSID supplemented its main data collection with additional information on children's education, health, cognitive and behavioral development, and time use.

Among eligible households in the core PSID sample, CDS-I completed interviews with 2,394 families (88%) providing information on up to two children per family, for a total sample size of 3,563 children aged 0-12 years. In 2002-2003 (CDS-II, Time 2), the CDS-II re-interviewed 2,019 families (91%) who had remained active in the PSID panel, gathering data on 2,907 children and adolescents between the ages of 5 and 18 years. In order to remain nationally representative, the CDS oversampled low-income, minority, and immigrant families (Hofferth, 1999). Approximately weighted, these data provide nationally representative estimates. For further details regarding sampling, sampling

weights, and data collection procedures, refer to the CDS user guide at http://psidonline.isr.umich.edu/CDS/cdsii_userGd.pdf.

The Sample for the Present Study

The effects of media on very young children have not been well studied. The current study examined long-term effects of screen media exposure on children younger than 3 years old. This study utilized two sub-samples from the CDS sample. First, the "diary subsample" contained 513 infants and toddlers between the ages of 1 month and 35 months whose parents completed at least one time diary (on a weekday or a weekend) at Time 1 and who had complete data on at least one of the three subsets of academic achievement tests at Time 2. Missing values on other variables were handled by Full Information Maximum Likelihood Estimation (FIML). The children in this sample were 48.5% boys and 51.5 % girls with a mean age of 19.70 months. The ethnic composition of the population is as follows: 51.9 % European American, 35.7 % African American, 7.8 % Hispanic, and 4.7 % other ethnicities (e.g., Asian American, Native American and others). The median income of families in CDS-I was $32,500, with 18.7% of families falling below the 1997 federal poverty level. The mean number of years of education of the family heads was 12.66 years (SD = 2.68), with a median of 12 years. Among the diary subsample of 513 infants and toddlers, 425 (83%) children didn't have siblings and 88 (17%) children had siblings. By age group, the sample broke down as follows: 1 to 23

months, n= 314 (infant group); 24 to 35 months, n= 199 (toddler group). The "television content subsample" comprised the 329 children between the ages of 1 month and 35 months whose diaries contained a sufficient amount of codeable television data from Time 1 and who had complete data on at least one of the three subsets of academic achievement tests from Time 2. Missing values on other variables also were handled by Full Information Maximum Likelihood Estimation (FIML). During the television program coding procedure (described below), many of the show titles recorded in the time diaries were incomplete or otherwise uncodeable. For instance, the educational content of entries such as "cartoons" or "channel 15" could not be determined. If over 30% of an individual child's television data was uncodeable, he or she was dropped from the sample. Ultimately, 329 infants and toddlers in the television content subsample had at least 70% codeable television data.

Among the diary subsample of 329 infants and toddlers, 291 (88%) children didn't have siblings and 38 (12%) children had siblings. The following sample sizes applied to the two age groups for the television content sample: 1 to 23 months, n= 156 (infant group); 24 to 35 months, n= 173 (toddler group).

DESCRIPTION OF MEASURES

Time Diaries

Central to the study at hand is the method that the CDS used to collect detailed information about children's time use. On one randomly chosen weekday and one randomly chosen weekend day, primary caregivers of the children in the CDS study were asked to complete a written, comprehensive time-use diary. Time-diary forms were mailed to parents with instructions indicating the day that they should be completed. (See Appendix A for an example of a time-diary page.) The primary caregiver, with help from the child when appropriate, completed the diary by accounting for every minute of activity performed by the child from midnight to 11:59 p.m. The primary caregiver recorded the start and end time of each activity (including sleep and school), as well as where the activity took place, who else was present during the activity, and what else the child was doing at the same time. The following day, researchers either contacted the parent by phone or visited the parent's home and reviewed the diary with him or her. At this time, the diary was edited for clarification if necessary (For a more complete description of the time diary, see Hofferth & Sandberg, 2001).

Collecting time-use data using a diary provides the highest quality and most valid data possible without an extraordinary commitment of time or money. While observational data may more accurately represent how children spend their time, it is

extremely costly and intrusive to gather. Summative data – asking parents to summarize the amount of time their child spends performing specific activities – is the simplest to collect. This method, however, is socially biased, and leads to higher estimates of positive behaviors and lower estimates of negative ones (Hofferth, 1999). The data collected using a time-use diary, on the other hand, has been found to be consistently valid and reliable (Juster & Stafford, 1985) and requires only a limited time commitment from participants and researchers. Furthermore, time-use diary reports of children's media use have been found to be very similar to observational data from videotapes made at children's homes (Anderson & Field, 1981).

Measures of Children's Time Use

Children's time use information was collected from 24-hour time-use diaries on one randomly chosen weekday and one randomly chosen weekend day. In the diary, every minute of the two 24-hour periods was accounted for with a primary activity and, if applicable, a secondary activity. The child's primary caregivers and, if possible, the child himself/herself reported all the activities in which the child was primarily or secondarily engaged. The primary caregivers of infants and toddlers between 1 and 35 months old completed the diaries on their child's behalf. Also reported were who else was doing the activity with the child and who was there but not participating directly in the activity with the child (e.g., if the parent was in the house but not watching television with the child).

On the day before their randomly chosen diary day, caregivers were reminded via phone call to keep track of their children's activities on the following day.

All time-use variables were constructed by summing the total number of minutes spent in each respective activity on a weekday and a weekend day. Duration totals included reports of activities as either primary or secondary. For descriptive analyses, number of minutes spent in each respective activity on a weekday and on a weekend were separately presented; however, for regression analyses, the total number of minutes spent over two days (a weekday and a weekend) were used. The following time use variables were examined: contextual variables (secondary activities and others present), early television exposure, and co-viewing with parents. In addition, time spent in daycare and time spent at home were used as control variables in the regression analyses.

Coding of contextual variables

In previous research, the context for television viewing has been an important determinant of its effects. In particular, examining the presence of secondary activities could be indirect way of examining the displacement hypothesis. Since the child can selectively attend to television, it is likely that viewing can occur in conjunction with other activities as opposed to simply displacing them.

Secondary Activities. Primary caregivers were asked if the child was participating in any other activity while watching television. The names of those activities were

recorded and later coded by the personnel at PSID into a broad range of categories, including household chores, personal care, organizational activities, entertainment/social activities, sports and active leisure, passive leisure, and travel. For the purposes of the present study, descriptive analyses of the secondary activities were conducted to determine which activities accompanied television viewing, along with how frequently those activities were mentioned. All reported activities were first classified into nine categories (no other activities, active play, creative play, general play, social interaction, eating, naps, reading/being read to, chores) based on the descriptive analyses and then collapsed into five new categories: (1) no other activities, (2) play (active, creative, general) (3) social interaction (4) eating (5) others (naps, reading/being read to, chores). Naps, reading/being read to and chores were combined into "others" because these activities occurred relatively infrequently (See Appendix B for complete activity definition).

Others present. Another contextual category describes who was with the child while he or she was watching TV/DVDs. Initial codes were collapsed into the following categories: (1) no one else present, (2) adult present (mother, father, step-mother, step-father, adoptive mother, adoptive father, grandparent), (3) child present (sibling, friend), (4) other person present (other relatives or other non-relatives whose age is unspecified), and (5) combination of persons (any combination of two or more of the above categories of persons at the same time). In regards to the final category, when the primary caregiver

reported more than one person with the child, that particular line of data was coded as "combination of persons" only, rather than given separate codes for each individual mentioned.

TV/DVD watching time in each of the contextual categories (secondary activities, others present) were computed as described above for total TV exposure and for each category of TV exposure. A proportion of the total minutes was calculated for each value of the contextual variables. For example, we know what percentage of infants' and toddlers' total television exposure time was spent viewing alone, co-viewing with adults, co-viewing with another child, and co-viewing with others. For the descriptive purposes, exclusive categories for co-viewing were created (e.g., "co-viewing adult" means viewing with a parent or grandparent but no other children and no other people present). Only parental co-viewing was used to predict subsequent cognitive development in the regression analyses. In this case, "parental co-viewing" means viewing with a parent and other children or other people could be there.

Early television exposure

Overall television exposure and each of the three types of television exposure (child-educational content exposure, child-noneducational content exposure, and adult content exposure) were computed by summing every instance of these types of screen media use recorded in each individual time diary. For descriptive purposes, television

exposure on weekdays and weekends was presented separately, but for the regression analyses, combined television exposure on a weekday and a weekend was used because the sample size was not large enough for separate analyses.

Overall television exposure. The total number of minutes that each child watched television was computed by summing every instance of media use throughout each individual time diary. The resulting number of minutes served as a measure of television exposure (including exposure to live broadcast or videos/DVDs) for the appropriate day type (i.e., weekday or weekend). As described above, for descriptive purposes, total television exposure was presented separately for the weekday and the weekend day, but for the regression analyses, total television exposure on both days was used because the sample size was not sufficiently large for separate analyses.

Additionally, for the regression analysis, four groups of total television exposure were created according to total duration of television exposure on both days. Because there were no differences between weekday and weekend viewing regardless of child age, weekday and weekend television exposure hours were summed and divided by 2, reflecting the average number of hours of television exposure per day. This resulted in 4 different groups: 1) No TV viewing, 2) 0-1 hour (per day), 3) 1-2 hours (per day), and 4) More than 2 hours (per day).

Television content coding. A unique feature of the CDS time diary is the inclusion of a query for television content. Whenever the primary caregiver reported television

viewing as the primary vity, he or she was also asked to indicate the title of the program the child was viewing and if it was being watched from a live broadcast or a videotape/DVD. Using prior knowledge about the program, including previous viewings of the program, as well as publicly available resources (e.g., websites such as www.tvguide.com, www.tvtome.com, or official websites for networks and programs), two raters coded the programs for a number of media-related variables. Two categories, "Intended Audience" and "Curriculum," were relevant for identifying child-educational programs, child-noneducational programs, and adult programs for this study (See Appendix C for Television Coding Sheet for Intended Audience and Curriculum). The Kappa estimates of inter-rater agreement ranged from .81 to .92 for the content categories used in this study.

Television shows were coded as child-educational if they met both of the following criteria for this study: (a) the intended audience was children, and (b) the curriculum was coded as pro-social or school readiness, such that the primary intention of the program appeared to be to promote appropriate and positive values, attitudes, behaviors, or inter-personal interactions (coded as pro-social curriculum) or to teach children specific skills and/or behaviors as preparation for school (coded as school readiness curriculum).

If the intended audience was children, but the curriculum was coded as 'no curriculum', 'extended academic learning', 'informal learning', or

'culture/science/history', the program was recoded as a child-noneducational program. If the intended audience was other than children (i.e., adolescents, adults, general), the program was coded as an adult program. The number of minutes per week of each category of television exposure was obtained by summing the weekday and weekend day for the regression analyses. However, for descriptive purposes, the number of minutes of each type of television exposure was presented separately for a weekday and a weekend.

Parental co-viewing

Co-viewing was defined in this study as viewing the television program with a parent or other primary caregiver. Information on co-viewing was obtained from the child's 1997 time diaries (Time 1). For each television program recorded in the time diary, the caregiver was asked to report who was participating in the activity (i.e., "who was doing the activity with the child") and who was present during the activity, but not participating (i.e., "who was there but not directly involved"). For example, when the primary or secondary activity was television and a parent (biological mother, biological father, step-mother, step-father, adopted mother, adopted father) was participating, the activity is considered co-viewing with the parent. The number of minutes a parent was there but not directly involved in the activity was excluded.

Four types of parental co-viewing were examined in this study: overall parental co-viewing, parental co-viewing of child-educational programs, parental co-viewing of

child-noneducational programs, and parental co-viewing of adult programs. Because these parental co-viewing variables had large numbers of children with values of 0 (co-viewing overall, 30.4%; co-viewing of child-educational content, 76.9%; co-viewing of noneducational content, 72%; co-viewing of adult content, 61.7%), a dichotomous variable (no co-viewing coded as 0 and co-viewing coded as 1) was created for each of the co-viewing variables except for co-viewing overall. These dichotomous co-viewing variables were used as predictors in the regression analyses. The number of minutes for overall parental co-viewing only used as a covariate in the analyses.

Cognitive outcomes

Cognitive outcomes were assessed for each child using the reading and math sections of the Woodcock Johnson Revised (WJ-R) Tests of Achievement at Time 2 . The WJ-R is a widely recognized measure of intellectual development, reading and mathematical competence (PSID-CDS User's Guide, 2002). The WJ-R is an 'easel' test, or a test with a response book that sits in front of the respondent. The interviewers place the easel at an angle so that they and the respondents can both see the stimuli (pictures) simultaneously. Since the WJ-R can be used for respondents from ages 2 to 90 years, items are arranged by difficulty for all persons between those ages. The easiest questions are presented first and the items become increasingly difficult as the respondent proceeds through the test (Woodcock & Johnson, 1989).

The WJ-R Tests of Achievement included three sub-sections: letter-word identification (57 items, M =110.77; SD=58.15), passage comprehension (43 items, M=108.63; SD=22.28), and applied problems (60 items, M=101.27; SD=17.77). The letter-word identification scale measured children's ability to recognize icons, pictures and words. The passage comprehension scale measured children's ability to recognize the word missing from an incomplete sentence. The applied problem scale measured math skills such as counting, inequalities and arithmetic. All assessments of cognitive ability were taken from the 2002 PSID-CDS (Time 2), when children were between the ages of 5 and 12 years old. All three measures were age standardized with a mean of 100. On average, across all age groups, test administration took approximately 40 minutes.

Covariates

Variables known to be related to children's television viewing and academic achievement were used as covariates. All of the covariates, including child age, child gender, child ethnicity, income-to-needs ratio, parental education, HOME, presence of older or younger siblings, amount of time spent in childcare, and amount of time spent at home, were measured at Time 1.

Child age. Child age was calculated as months from birth to the time of the Primary Caregiver (PCG) Interview at Wave 1. Age in months was typically used as a covariate in most analyses. In some analyses, however, it was also used as a categorical

variable, partly because AAP recommendations focus on children younger than 2 years, and partly because children pass through very different developmental stages between the ages of 1 month and 35 months.

In these cases, child age from Time 1 was divided into two groups: an infant group (1-23 months), and a toddler group (24-35 months). These categories were selected to match predicted developmental differences in comprehension and effects of television content, consistent with cognitive developmental theory and prior research (Flavell, 1963; Piaget, 1969; Anderson & Pempek 2005). Learning from television may be difficult for children under two who are in the sensory-motor stage. TV is a symbolic medium, which is more cognitively demanding than physical reality; as such, it may require children to be capable of mental representation, which occurs in the preoperational stage, or generally after the age of two years (Piaget, 1969).

Child gender. Child gender was coded as a dummy variable, where boys were coded as 1 and girls were coded as 0.

Child Ethnicity. Child ethnicity was coded as a dummy variable, where white was coded as 1 and non-white (combining Black, Hispanic, Asian and other ethnicities) was coded as 0.

Income to needs ratio. The income to needs ratio was determined by dividing each family's reported total income by the poverty threshold. The Census Bureau reports an annual poverty threshold that takes family size into account.

Parent's education. Parental education was measured by the number of years of education the head of the household had completed.

Presence of older or younger sibling(s). The CDS data did not include the child's birth order, although it did include number of siblings. Therefore, for all children who had a sibling reported as residing in the household, two dummy variables were created using the birth date of each child in the household. Any siblings not residing in the household could not be included, because they were not considered part of the household unit. Although this means that some older siblings may not have been accounted for, the risk of missing the effect of these siblings on television viewing was minimal, given that it was siblings' presence that was likely to impact viewing. A dummy variable (yes/no) was created indicating the presence of an older sibling – that is, a sibling, step-sibling or foster sibling – who had a birth date occurring before that of the target child and who resided in the home. Likewise, a dummy variable was created for the presence of a younger sibling – that is, a sibling who had a birth date falling after that of the target child and who resided in the household, as defined by the PSID.

Home environment. The quality of the child's home environment was assessed using the short form Home Observation for Measurement of the Environment (HOME). HOME included both observational data reported by interviewers and self-report data submitted by the primary caregiver. The measure comprised information about educational materials in the home, parents' sensitivity and child stimulation, and

opportunities for a variety of experiences outside the home. This measure was a strong predictor of educational television viewing (Wright et al., 2001) and of academic achievement (Caldwell & Bradley, 1984). The scale differs slightly for children of different age groups; therefore, scores were standardized within each age group.

Amount of time spent in daycare. Because time spent in daycare limits the amount of children's discretionary time, the numbers of minutes spent in daycare was included as a control variable.

Amount of time spent at home. Because the amount of time spent at home is related to the amount of children's exposure to television, the number of minutes spent at home was used as a control variable. The amount of time spent at home was created by subtracting the number of minutes spent sleeping (naps and night sleep) and number of minutes spent in daycare from 1440 minutes (24 hours) for a weekday and a weekend separately and then summing the amount of time spent at home on both days.

ANALYSIS PLAN

Overarching Analytic Strategies

The research questions of this study were mostly addressed through OLS multiple regressions. There were a number of attributes of the CDS data, such as issues regarding sample weight, non-independent data, and missing data, however, that complicated these analyses and demanded specific analytical attention.

Sampling weight

The CDS data are based on an oversample of low-income families, mostly African Americans, as well as a new immigrant sample. Additionally, as a panel study, CDS-II data had a sample attrition issue. The reduction in the sample was due to reclassification of the eligibility status of a number of CDS-I sample participants and also due to nonresponse among the remaining eligible CDS families. To account for differential probabilities of selection due to the original PSID sample design and subsequent attrition, CDS data were provided with weights. All the analyses, therefore, were performed using a CDS-II child level sampling weight, which was recalibrated (or calculated) to adjust for the original probability of sample selection and for attrition between 1997 and 2002. Using this weight, the CDS data were a nationally representative sample.

Nested nature of the data

The CDS sample included up to two children randomly selected from each family in the PSID. In cases in which siblings from the same families were included in the CDS, there was family level information (e.g., family income-to-needs ratio, parental education, mother's average work hours) and child level information (e.g., child cognitive ability, time use variables) from the same reporter. Analyses using non-independent data can result in deflated error estimates that increase the type 1 error rate.

Thus, non-independence in the CDS sample was corrected using the CLUSTER function in the analyses in Mplus 7.11.

Missing data

The missing values on variables were handled by full information maximum likelihood estimation (FIML). Thus, the current study maintained the same sample size in all analyses. The characteristics of the CDS data were handled by using MLR in Mplus. MLR, one type of FIML, is a maximum likelihood estimator with robust standard errors using a numerical integration algorithm. The estimates by MLR (robust ML) are robust to non-normality and non-independence of cluster data or complex survey data that is weighted (Muthén & Muthén, 2006). The following analyses were performed in Mplus 7.11.

Analyses Addressing the Research Questions and Proposed Hypotheses

The main purpose of this study is to examine the longitudinal association of TV viewing between 1 and 35 months with academic achievement in early childhood, defined as between the ages of 5 and 8 years old. The analyses most appropriate for answering each research question vary and are outlined below.

Descriptive analyses

Children under three years old have not been regarded as TV viewers for several reasons. Due to a dearth of studies on TV exposure in very early childhood (especially infancy), the first purpose of this study is to provide comprehensive information regarding the television viewing context for infants and toddlers. Descriptive analyses were conducted to answer questions such as, "How much are infants and toddlers are exposed to television?", "What are these infants and toddlers exposed to?", "Whom do they co-view with?", "What do they co-view?", and "What are they doing while the television is on?". The average number of minutes on a weekend and on a weekday are presented separately in tables and figures to show both the amount of time exposed to each type of television content and the total amount of television exposure. The average number of minutes for each age group (infant and toddler) are also presented separately, along with the average for the total group. The contextual variables were described in terms of minutes and proportion of total time.

How does early television exposure influence later cognitive outcomes, especially longitudinal effects on academic achievement?

To analyze the relations between early television exposure and later academic achievement, multiple OLS regressions were conducted on each of the three different types of television content (child-educational content, child-noneducational content, and

adult content) and each of the four groups categorized according to total duration of television exposure (no TV group, 0 to 1 hour group, 1 to 2 hours group, and more than 2 hours group). Multiple regressions were performed separately for three subsets of academic achievement tests (i.e., letter-word recognition, passage comprehension, applied problem). In addition, regressions were tested separately for each child age group (infant, 1-23 months; or toddlers, 24-35 months). In these analyses, child age, child gender, child ethnicity, family income-to-needs ratio, parental education, HOME, presence of older or younger siblings, amount of time spent in daycare, and amount of time spent at home were entered as covariates. In addition, the total number of minutes exposed to television was also used as a covariate in order to account for the association between total amount of television viewing and subsequent cognitive outcomes in the analyses.

Additional analyses tested for interactions between exposure to each of the three television categories and child age (child-educational content x child age, child-noneducational content x child age, adult content x child age). In order to avoid issues of multicollinearity, television content variables and child age were centered on their means (that is, the sample mean was subtracted from each score) before the interaction terms were created (Aiken & West, 1991). In cases in which there was a significant age interaction effect, additional regression analyses were conducted separately for child age group (infant, 1-23 months; or toddlers, 24-35 months).

How does parental co-viewing moderate the relations between early television exposure and subsequent cognitive outcomes?

In order to test the role of parental co-viewing in moderating the association between early television exposure and later academic achievement scores, a series of multiple linear regressions were utilized. In these analyses, child-educational co-viewing with parents, child-noneducational co-viewing with parents, and adult program co-viewing with parents were used as predictors in order to predict academic achievement scores (letter-wood identification, passage comprehension, applied problem) measured at Time 2. Because large proportions of children did not co-view with parents, dichotomous variables (no co-viewing coded as 0 and co-viewing coded as 1) were created for each of the co-viewing variables.

In theses analyses, child age, child gender, child ethnicity, family income-to-needs ratio, parental education, HOME, presence of older or younger siblings, amount of time spent in daycare, and amount of time spent at home were entered as covariates. In addition, the number of minutes for overall parental co-viewing was also used as a covariate in the analyses in order to account for association of total parental co-viewing to subsequent cognitive outcomes in the analyses.

Chapter 4: Results

PRELIMINARY ANALYSES

Preliminary data analyses proceeded from attrition analyses, to univariate, to bivariate before examining the main research questions. First, attrition analyses were conducted to compare the final sample to the sample initially available with respect to all of the covariates (i.e., child age, child gender, child ethnicity, family income-to-needs ratio, parent's education, HOME, presence of older or younger siblings, time spent in daycare, and time spent at home) in order to ensure that the findings were robust regardless of these demographic characteristics.

Among 3,563 children aged 0-12 years, the total sample of CDS-I, there were 743 children aged 0 to 35 months. Among these 743 infants and toddlers, the diary sample only included a total of 513 children who had completed at least one CDS-I time diary and who had later completed at least one of the three subsets of academic achievement tests at CDS-II (2002). Infants and toddlers included in the diary sample were more likely to be White, $\chi^2(1) = 4.97$, $p < .05$, and were more likely to have younger siblings, $\chi^2(1) = 5.78$, $p < .05$, than those who were not in the sample. The two groups did not differ on child age, child gender, family income-to-needs ratio, parent's education, HOME, presence of older siblings, time spent in daycare, and time spent at home.

Among children included in the diary sample, 184 children were excluded from the TV content subsample because they were not exposed to television on a weekend or on a weekday at all, and/or did not have dairies that contained a sufficient amount of codeable television data from Time 1. Children included in the TV content sample were older, t (511) = 13.16, $p < .001$; had a lower family income-to-needs ratio, t (466) =-2.18, $p < .05$; had parents with less education, t (499) =-2.24, $p < .05$; and were more likely to have younger siblings $\chi^2(1) = 11.89$, $p < .01$ than those excluded. The two groups did not differ in terms of gender, child ethnicity, HOME, presence of older siblings, time spent in daycare, and time spent at home.

Second, univariate tests were conducted to ensure that assumptions such as variable normality were met for the multivariate analyses. Multivariate normality can be detected by skewness and kurtosis of univariate distribution. Skewness and kurtosis of all the variables, except for the variables for exposure to different television content (child-educational programs, child-noneducational programs, adult programs), were within the range of 1.96, indicating acceptable boundaries of normality. Because these television content variables (child-educational programs, child-noneducational programs, adult programs) were positively skewed, distributions of raw scores, square-root-transformed scores, and log-transformed scores were computed, and statistics for skewness and kurtosis were inspected. The square-root transformation most consistently produced satisfactory improvements in normality. Consequently, the square-root transformation for

the television content variables (child-educational programs, child-noneducational programs, adult programs) was used for OLS regressions. The mean presented in the tables and figures displaying the categories of television exposure, however, are estimated raw minutes per week. Graphing raw minutes provides numbers that are more clearly interpretable, and this method is comparable to procedures used in other time use studies, particularly those of television time use (e.g., Bianchi & Robinson, 1997; Timmer et al., 1985). Means and standard deviations for all the variables used in the analyses are presented in Table 4.1 for the diary sample and Table 4.2 for the TV content sample.

Third, bivariate analyses, including correlations for all the variables used in this study were conducted, and are presented in Table 4.3 for the diary sample and Table 4.4 for the TV content sample. Correlation coefficients among all the variables in this study fell between low and moderate levels of covariance (e.g., <.85), indicating that there were no issues regarding multicollinearity.

These correlations provide initial impressions on whether the hypothesized relationships were significantly related. As seen in Table 4.3, among the dairy sample, total television exposure was not related to the any of academic achievement test scores. Among total television exposure groups, the "No TV" group, the "0 to 1 hour" group and the "more than 2 hours" group were negatively related to academic achievement subtest scores; while the "1 to 2 hours" group was positively related to all of the achievement

scores. Infants and toddlers who were exposed to 1 to 2 hours television per day were likely to have higher scores on achievement tests than those from any other group. As regards the covariates, total television exposure was negatively related to income-to-needs ratio, parental education and HOME; conversely, it was positively associated with presence of younger siblings and amount of time spent at home. In other words, infants and toddlers who had a lower income-to-needs ratio, lower HOME sores and parents with lower education were likely to be exposed to more television; children who had younger siblings and spent more time at home were also likely to be exposed to more TV.

Among the television exposure groups, infants and toddlers who were not exposed to any television were more likely to be white, less likely to have younger siblings, and less likely to spend time at home. Children who were exposed to 0 to 1 hour per day of television were likely to have a higher income-to-needs ratio. Children who were exposed to more than 2 hours per day of television were likely to have a lower income-to-needs ratio, parents with lower education, younger siblings, and to spend more time at home. As regards the academic achievement subtest scores, child age, income-to-needs ratio, HOME, and parental education, and amount of time spent in daycare were all positively associated with the achievement test scores. In other words, children who were older, had a higher income-to-needs ratio and HOME scores, had parents with higher education, and spent more time in daycare were more likely to have higher academic test

scores. A relationship between child gender and achievement test scores also emerged: boys were likely to have lower academic scores than girls were.

Among the TV content sample, as seen in Table 4.4, there was no relationship between exposure to child-educational content and academic test scores. Exposure to child-noneducational content was positively related to the applied problem scores, while exposure to adult content was negatively related to the letter word identification and applied problem scores. Overall parental co-viewing was negatively related to the applied problem scores, but parental co-viewing of different types of programs was not related to any of the academic achievement subtest scores. Infants and toddlers who were younger and who spent more time at home were likely to be exposed to more child-educational programs. Girls and children who were younger were also likely to be exposed to more child-noneducational programs. Boys who had parents with less education, had lower HOME scores, and spent more time at home were more likely to be exposed to adult content. Regarding parental coviewing, infants and toddlers who didn't have any older siblings were likely to co-view child content (child-educational, child-noneducational content) with their parents. Children who were older and had parents with less education were likely to co-view child-noneducational programs with their parents. Boys were more likely to co-view adult content with their parents.

Table 4.1. Means and Standard Deviations for All Measures for the Diary Sample (N=513)

	Mean	SD
Outcomes (Time 2)		
Letter-word identification	107.12	17.10
Passage comprehension	111.06	15.06
Applied problem	101.02	18.05
Predictors (Time 1)		
Total television exposure [a]	188.74	190.47
No TV group [b]	.23	.42
0 to < 1 hour group [b]	.21	.41
1 to <2 hour group [b]	.20	.40
≥ 2 hour group [b]	.35	.48
Covariates (Time 1)		
Child age in month	19.71	9.74
Child gender [c]	.49	.50
Child ethnicity [d]	.52	.50
Income-to-needs ratio	2.89	2.48
Parental education	12.67	2.67
HOME	14.58	1.90
Presence of older siblings [b]	.56	.50
Presence of younger siblings [b]	.09	.28
Amount of time spent in daycare [a]	77.15	188.44
Amount of time spent at home [a]	1301.48	253.06

Note. [a.] minutes; [b] 0=no, 1=yes ; [c] 0=girl, 1=boy; [d] non-white=0, white=1

Table 4.2. Means and Standard Deviations for All Measures for the TV Content Sample (n=329)

	Mean	SD
Outcomes (Time2)		
Letter-word identification	108.19	17.288
Passage comprehension	111.70	14.963
Applied problem	102.40	17.590
Predictors (Time1)		
Total television exposure [a]	264.90	180.29
Child-educational content exposure [a]	56.02	78.18
Child-noneducational content exposure [a]	60.15	80.04
Adult content exposure [a]	56.21	80.06
Overall parental co-viewing [a]	86.71	111.33
Parental co-viewing of child-educational content [a]	15.56	41.64
Parental co-viewing of child-noneducational content [a]	20.08	43.63
Parental co-viewing of adult content [a]	33.47	63.59
Covariates (Time1)		
Child age in month	23.37	8.53
Child gender [b]	.48	.50
Child ethnicity [c]	.50	.50
Income- to-needs ratio	2.71	2.28
Parental education	12.48	2.86
HOME	14.48	1.85
Presence of older siblings [d]	.56	.50
Presence of younger siblings [d]	.12	.32
Amount of time spent in daycare [a]	77.76	184.85
Amount of time spent at home [a]	1318.61	231.76

Note. [a.] minutes; [b] 0=girl, 1=boy; [c] non-white=0, white=1; [d] 0=no, 1=yes

Table 4.3. Bivariate Correlation among All Variables used in Regression Analyses for Diary Sample (N=513)

	1	2	3	4	5	6	7	8	9
1. Letter-word	1.0								
2. Passage comprehension	.77**	1.0							
3. Applied problem	.60**	.52**	1.0						
4. Total television exposure [a]	.03	.02	.06	1.0					
5. No TV group [b]	-.09*	-.08	-.15**	-.55**	1.0				
6. 0 to < 1 hour group [b]	-.09*	-.07	-.02	-.34**	-.32**	1.0			
7. 1 to < 2 hour group [b]	.20**	.20**	.15**	.04	-.31**	-.30**	1.0		
8. ≥ 2 hour group [b]	-.01	-.04	.03	.80**	-.37**	-.36**	-.34**	1.0	
9. Child age in month	.17**	.13**	.17**	.45**	-.52**	-.03	.17**	.37**	1.0
10. Child gender [c]	-.15**	-.11*	-.09	.05	-.02	-.01	-.05	.07	-.03
11. Child ethnicity [d]	.07	.15**	.21**	-.07	.09*	-.04	.04	.07	-.03
12. Income-to-needs ratio	.16**	.06	.26**	-.16**	.04	.11*	-.02	-.13**	-.02
13. Parental education	.24**	.25**	.31**	-.20**	.05	.04	.09	-.17**	-.01
14. HOME	.19**	.14**	.13**	-.11*	.09	-.02	.02	-.09	.45
15. Presence of older siblings [b]	-.05	-.01	.02	-.02	-.01	-.01	.07	-.05	-.02
16. Presence of younger siblings [b]	.01	-.03	.08	.15**	-.11*	-.01	-.01	.12**	.30**
17. Amount of time spent in daycare [a]	.11*	.09	-.01	-.04	-.03	.02	.02	-.01	.11*
18. Amount of time spent at home [a]	-.07	.02	-.02	.18**	-.09*	-.08	.01	.12**	.16**

Table continues

Table 4.3 continued

	10	11	12	13	14	15	16	17	18
1. Letter-word									
2. Passage comprehension									
3. Applied problem									
4. Total television exposure [a]									
5. No TV group [b]									
6. 0 to < 1 hour group [b]									
7. 1 to < 2 hour group [b]									
8. ≥ 2 hour group [b]									
9. Child age in month									
10. Child gender [c]	1.0								
11. Child ethnicity [d]	-.06	1.0							
12. Income-to-needs ratio	.08	.18**	1.0						
13. Parental education	-.03	.35**	.47**	1.0					
14. HOME	-.21**	.24**	.08	.27**	1.0				
15. Presence of older siblings [b]	.05	-.04	-.14**	-.06	-.08	1.0			
16. Presence of younger siblings [b]	-.04	-.01	-.02	-.06	-.03	-.10*	1.0		
17. Amount of time spent in daycare [a]	-.03	-.05	.06	.10*	.08	-.03	-.08	1.0	
18. Amount of time spent at home [a]	.02	.05	-.05	-.09*	.03	-.08	.10*	-.48**	1.0

Notes. [a] minutes; [b] 0=no, 1=yes ; [c] 0=girl, 1=boy; [d] non-white=0, white=1; *$p < .05$, ** $p < .01$

Table 4.4. Bivariate Correlation among All Variables used in Regression Analyses for TV Content Sample (N=329)

	1	2	3	4	5	6	7	8	9	10
1. Letter-word	1.0									
2. Passage comprehension	.77**	1.0								
3. Applied problem	.61**	.53**	1.0							
4. Total television exposure [a]	-.07	-.04	-.02	1.0						
5. Child-educational content exposure [a]	.01	-.06	.03	.41**	1.0					
6. Child-noneducational content exposure [a]	.04	.09	.12*	.48**	.05	1.0				
7. Adult content exposure [b]	-.12*	-.08	-.13*	.49**	.02	.09	1.0			
8. Overall parental co-viewing [a]	-.08	-.01	-.13*	.53**	.28**	.27**	.53**	1.0		
9. Parental co-viewing of child-educational content [a]	-.01	-.02	-.01	.15**	.55**	-.07	-.02	.52**	1.0	
10. Parental co-viewing of child-noneducational content [a]	-.08	.04	-.07	.34**	.04	.63	.14*	.58**	.05	1.0
11. Parental co-viewing of adult content [a]	-.11	-.02	-.16	.40**	.01	.06	.85**	.66**	.03	.21**
12. Child age in month	.06	.11	.04	.23**	.11*	.23**	.08	.12*	.04	.15**
13. Child gender [c]	-.17**	-.11	-.06	.09	.02	-.12*	.19**	.06	.03	-.09
14. Child ethnicity [d]	.06	.17**	.24**	-.02	.05	.03	-.04	-.05	-.03	.04
15. Income-to-needs ratio	.16**	.10	.22	-.10	.03	.00	-.09	-.08	.05	-.02
16. Parental education	.25**	.25**	.35**	-.20**	-.01	-.04	-.14*	-.19**	-.05	-.18**
17. HOME	.20**	.15*	.26**	-.07	.08	.03	-.15**	-.07	.01	.05
18. Presence of older siblings [b]	-.01	-.01	.06	-.04	-.07	.01	.01	-.19**	-.18**	-.18**
19. Presence of younger siblings [b]	-.06	-.05	.01	.11	.11	.09	.01	-.01	-.01	.011
20. Amount of time spent in daycare [a]	.14**	.11	.03	-.09	-.10	-.01	-.06	-.01	-.02	.03
21. Amount of time spent at home [a]	-.06	.10	-.01	.24**	.14*	.10	.13*	.09	-.05	.09

Table continues

Table 4.4 continued

	11	12	13	14	15	16	17	18	19	20	21
1. Letter-word Identification											
2. Passage comprehension											
3. Applied problem											
4. Total television exposure [a]											
5. Child-educational content exposure [a]											
6. Child-noneducational content exposure [a]											
7. Adult content exposure [b]											
8. Overall parental co-viewing [a]											
9. Parental co-viewing of child-educational content [a]											
10. Parental co-viewing of child-noneducational content [a]											
11. Parental co-viewing of adult content [a]	1.0										
12. Child age in month	.03	1.0									
13. Child gender [c]	.14*	-.05	1.0								
14. Child ethnicity [d]	.04	.05	.03	1.0							
15. Income-to-needs ratio	-.09	.02	-.04	.36**	1.0						
16. Parental education	-.08	.03	-.04	.40**	.48**	1.0					
17. HOME	-.14	.14*	-.29**	.29**	.19**	.27**	1.0				
18. Presence of older siblings [b]	-.04	-.03	.08	-.12*	-.22**	-.11	-.11	1.0			
19. Presence of younger siblings [b]	-.03	.24**	-.05	.02	-.11	-.08	-.01	-.10	1.0		
20. Amount of time spent in daycare [a]	-.05	.17**	-.06	-.01	.11	.11	.02	-.01	-.12*	1.0	
21. Amount of time spent at home [a]	.10	.07	.06	.06	.01	-.07	.07	-.09	.13*	-.54**	1.0

Notes. [a] minutes; [b] 0=no, 1=yes ; [c] 0=girl, 1=boy; [d] non-white=0, white=1; *$p < .05$, ** $p < .01$

TELEVISION VIEWING CONTEXTS IN INFANCY AND TODDLERHOOD

In order to provide comprehensive information regarding television viewing contexts likely to be operative in infancy and toddlerhood, descriptive analyses were conducted to answer questions such as: how much infants and toddlers are exposed to television and what they watch, whom they co-view with, what they co-view, and what they are doing while the television is on (i.e., secondary activities). The average number of minutes on a weekend and on a weekday are presented separately in tables and figures to show the amount of time exposed for each type of television content and in total, with different categories of persons present, and different amounts of time spent in secondary activities. The average number of minutes for different age groups (infant, toddler) are also presented separately, along with an average for the total group. The contextual variables are described both in number of minutes and in proportion of total time spent.

How much are Infants and Toddlers Exposed to Television?

Children under three were exposed to an average of 1 hour and 34 minutes of television and video/DVDs on weekdays and 1 hour and 33 minutes on weekends. Infants were exposed to an average of 1 hour and 8 minutes on weekdays and 1 hour and 6 minutes on weekends; toddlers were exposed to an equal amount of television on weekdays and on weekends, averaging of 2 hours and 18 minutes.

These are averages and so reflect a great deal of variation, from children who spend no time exposed to TV, to those who spend an extraordinary amount of time

exposed to TV. Figures 4.1 though 4.3 show the amount of time three groups (infants, toddlers, and all children) are exposed to television on weekdays and on weekends. Almost half of the infants were exposed to television on weekdays and weekends (51%, 55%, respectively); only 11% of toddlers were not exposed to television on weekdays and on weekends. Twenty-two percent of infants were exposed to 2 or more hours of television on weekdays and on weekends; half of the toddlers were exposed to 2 or more hours of television on weekdays and on weekends (53%, 52% respectively). This shows that overall, toddlers were more exposed to television compared to infants, and that exposure times for toddlers were similar on weekdays and weekends.

What are Infants and Toddlers Exposed to?

Among children who were exposed to television, infants and toddlers were exposed to an average of 33 minutes of child-educational programs, 29 minutes of child-noneducational programs and 27 minutes of adult programs on the weekday, and an average of 23 minutes of child-educational content, 31 minutes of child-noneducational content, and 31 minutes of adult audience programs on the weekend .

For the infant group, on weekdays, children were exposed to child-educational content, child-noneducational content and adult content on TV (30 minutes, 19 minutes, and 22 minutes, respectively); on weekends, children were exposed to child-educational content, child-noneducational content and adult content on TV (18 minutes, 23 minutes, and 23 minutes, respectively). Toddlers were exposed to child-educational content, child-noneducational content and adult content on TV (36 minutes, 39 minutes, and 31

minutes, respectively); on weekends, toddlers were exposed to child-educational content, child-noneducational content and adult content on TV (28 minutes, 38 minutes, and 36 minutes, respectively). Overall, on weekdays, children were more exposed to child-educational content than to other types of content; on weekends, children were less exposed to child-educational content compared to child-noneducational and adult programs.

As seen in Table 4.5, among child-educational programs, the most popular program was *Barney* (44%). Children under three spent 17% of their television time watching *Sesame Street*, followed by *Winnie the Pooh* (8%), *Arthur* (5%) and *Blue's Clues* (3%). Among child-noneducational content and adult content, infants and toddlers were not exposed to any particular programs and were exposed to diverse titles.

Table 4.5. Popular Titles (Proportion of each Television Category) According to Content Type among Children aged 0 to 35 months

Child-Educational Programs	**Child-Noneducational Programs**	**Adult Programs**
Barney (44%)	Rugrats (5%)	News (7%)
Sesame Street (17%)	Power rangers (4%)	Sports(i.e.,-baseball, basketball, football)(7%)
Winnie The Pooh(8%)	Flintstones (cartoon) (4%)	Soap Opera (3%)
Arthur (Cartoon)(5%)	Tiny Toon Adventures (4%)	Wheel of Fortune (2%)
Blue's Clues (3%)	Toy Story (4%)	America's Funniest Home Videos (2%)
Mister Rogers' Neighborhood (1%)	Lion King (3%)	Home Improvement (1%)

Figure 4.1. Amount of Time Exposed to Television by Children aged 0 to 35 months (N=513)

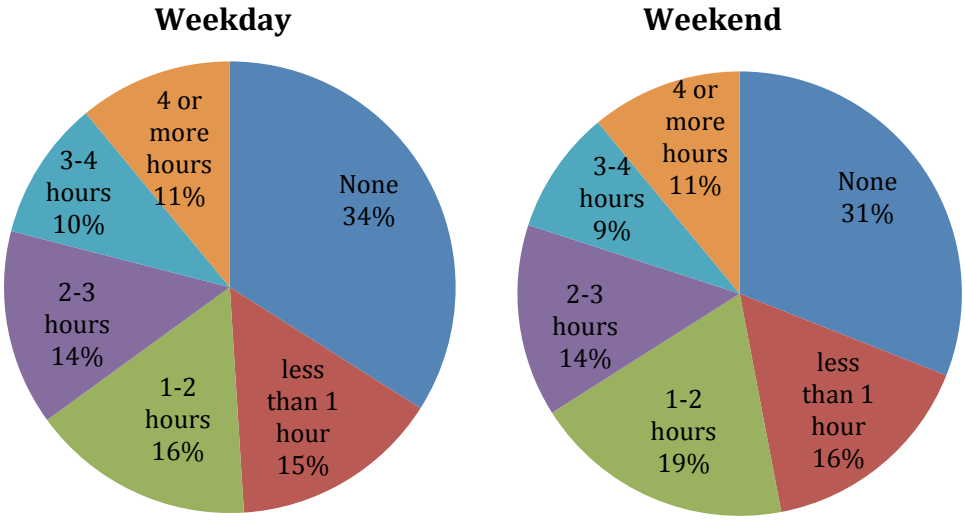


Figure 4.2. Amount of Time Exposed to Television by Infants aged 0 to 23 months (N=314)

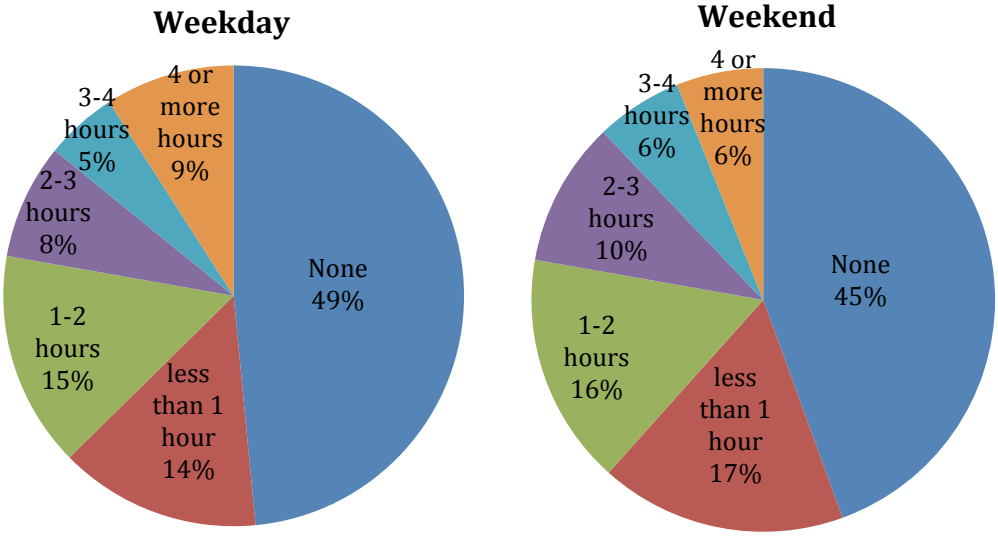
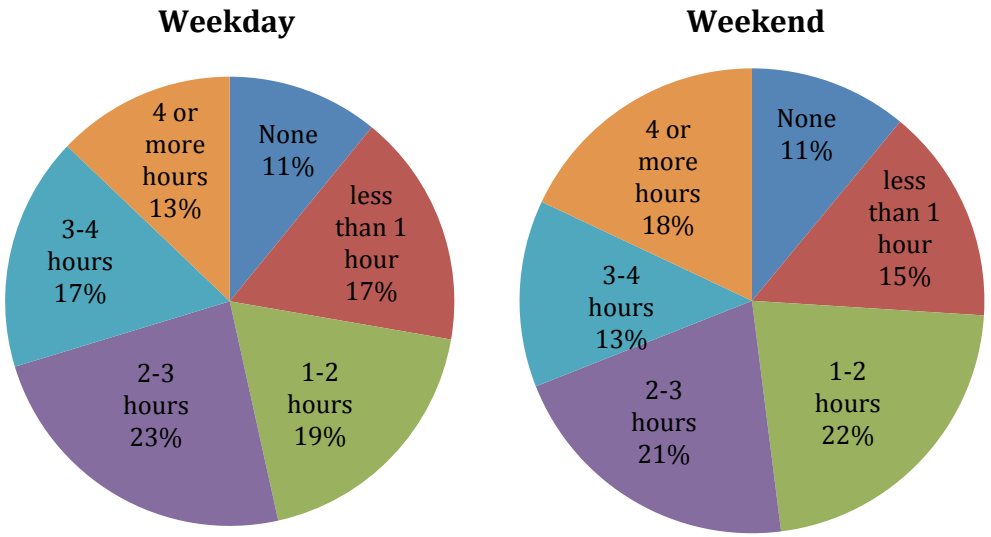


Figure 4.3. Amount of Time Exposed to Television by Toddlers aged 24 to 35 months (N=199)



Whom Do Infants and Toddlers Co-view with?

Figures 4.4 and 4.5 show the percentage of viewing time infants and toddlers spent alone versus with others. About thirty percent of children's television viewing was a solitary activity (31% on a weekday and 29% on a weekend). In large part, they watch television with adults (33% on a weekday and 27% on a weekend), and next most frequently with other children present, either siblings or friends (23% on a weekday and 22% on a weekend).

Figure 4.4. Mean Proportion of Total Time Spent with Others While Watching TV On Weekday (N=329)

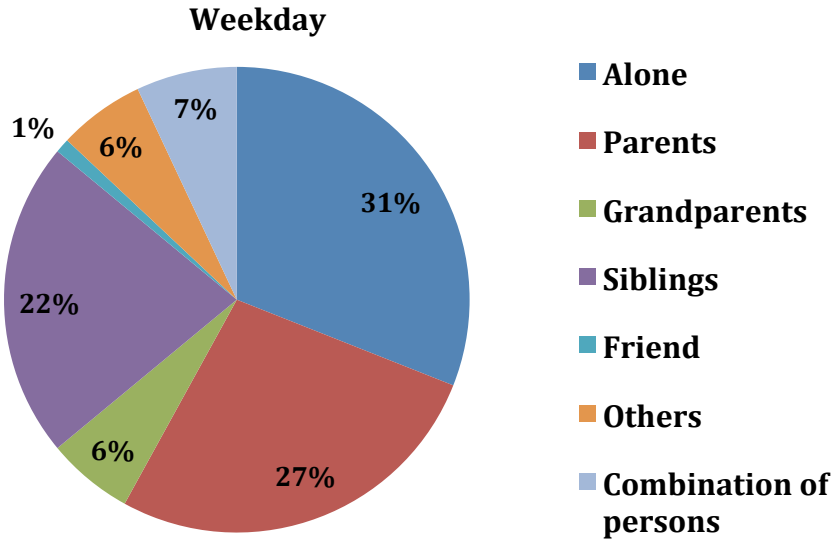
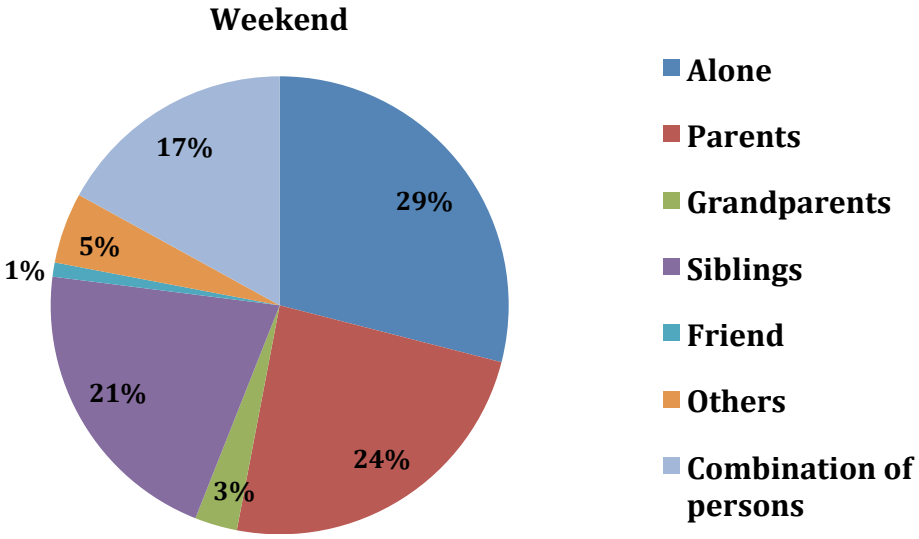


Figure 4.5. Mean Proportion of Total Time Spent with Others While Watching TV on a Weekend



What Do Infants and Toddlers Co-view?

It can be assumed that children watch different kinds of programs when viewing alone versus with others. There were five viewing categories: (1) alone (2) adults present (parents and grandparents), (3) other children present (siblings and friends), (4) others present (other relatives and non-relatives), (5) combination of persons (any combination of two or more of the above categories of persons at the same time). As shown in Table 4.6, between 14% and 39% of children's television viewing is a solitary activity. Children watched different kinds of programs when viewing alone versus with others. They watched alone or co-viewed with someone else a pretty similar amount of each type of television program on a weekday and on a weekend. When they watch alone, 74% of their television time was spent watching child audience programs (child-educational and child-noneducational programs) on a weekday and 64% of their television time was spent watching child audience content on the weekend. When they co-viewed with adults (parents and grandparents combined), 40% of their television time was spent watching adult content on a weekday and 34% of their television time was spent watching adult content on the weekend.

Table 4.6. Average Minutes and Percentages of Co-viewing of Each Type of television Programs on a Weekday and on a Weekend (N=329)

	Weekday					
	Child-educational		Child-noneducational		Adult audience	
Co-viewing w/:	Minutes	%	Minutes	%	Minutes	%
Alone	12	39%	11	35%	4	14%
Children present	8	26%	8	25%	5	18%
Adult present	7	22%	9	28%	11	40%
Others present	3	10%	2	6%	4	14%
Combination of persons	1	3%	2	6%	4	14%
	Weekend					
	Child-educational		Child-noneducational		Adult audience	
Co-viewing w/:	Minutes	%	Minutes	%	Minutes	%
Alone	8	36%	8	28%	5	19%
Children present	6	27%	8	28%	4	16%
Adult present	6	27%	7	24%	9	34%
Others present	1	5%	2	6%	1	3%
Combination of persons	1	5%	4	14%	7	28%

What are the Secondary Activities that Occur alongside Television Viewing?

Because young children tend to do a lot of things at once, it is also important to understand what they do while watching TV. As can be seen in Figure 4.6, 56% of children under three do something else while they watch TV. The most frequent non-viewing behaviors were playing (30%) and social interaction (19%). The most common types of play involved creative play (15%), followed by general play (11%) and active play (4%). Although children spent a small amount of their viewing time eating (6.6%) or reading/being read to (1%), these activities tend to become more common at older ages. Similar patterns of non-viewing behaviors were presented for the infant group and the toddler group in figures 4.7 and 4.8. The popular depiction of children being "mesmerized" by the screen certainly doesn't apply to television's youngest viewers, who are much more active in front of the set than older children and adults.

Figure 4.6. Percentage of Time Spent in Secondary Activity while Watching TV: Children aged 0-35 months

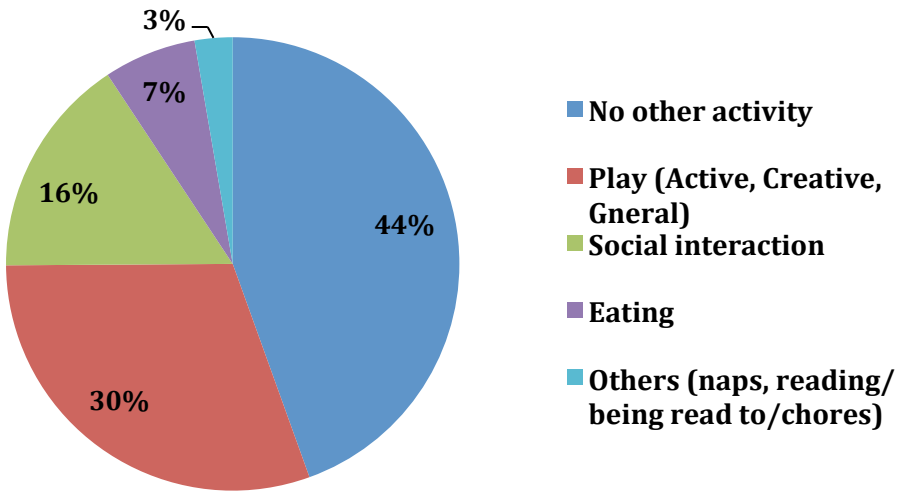


Figure 4.7. Percentage of Time Spent in Secondary Activity while Watching TV: Infants aged 0-23 months

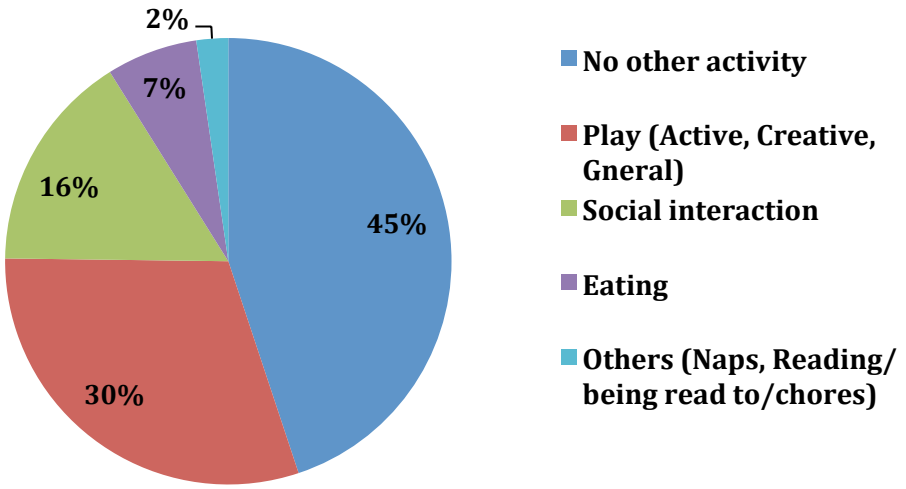
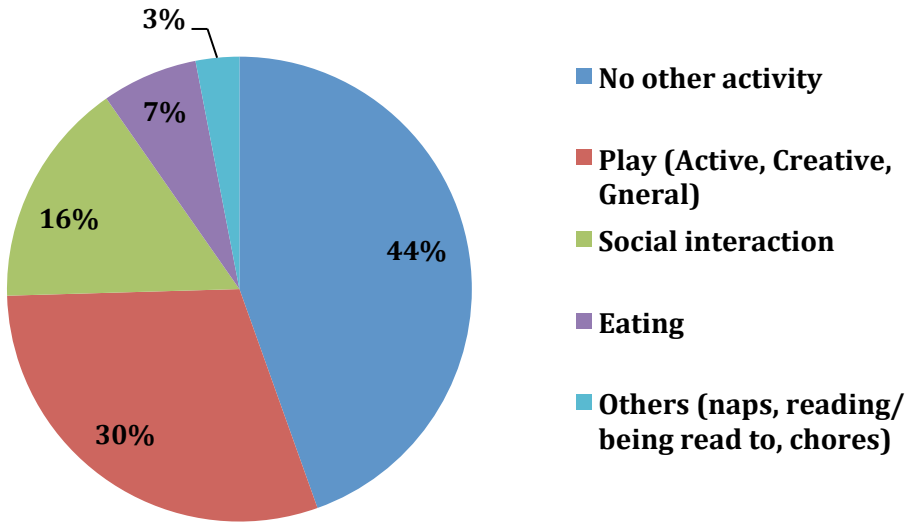


Figure 4.8. Percentage of Time Spent in Secondary Activity while Watching TV: Toddlers aged 24-35 months



THE LONG-TERM EFFECTS OF EARLY TELEVISION EXPOSURE ON SUBSEQUENT COGNITIVE OUTCOMES

Multiple regression analyses were conducted to examine the long-term effects of early television exposure on subsequent cognitive outcomes. The following predictors were included in the model: four groups categorized according to the average of total duration of television exposure on a weekday and a weekend (no TV group, 0 to 1 hour group, 1 to 2 hours group, and more than 2 hours group), child-educational content, child-noneducational content, and adult content. Three achievement test scores – letter-wood, passage comprehension, and applied problem scores – were used as dependent variables. Child age, child gender, child ethnicity, family income-to-needs ratio, parental education, HOME, presence of older or younger siblings, amount of time spent in daycare, and amount of time spent at home were entered as covariates. For each category of content, total television exposure was also used as a covariate in order to account for the association between total amount of television viewing and subsequent cognitive outcomes in the analyses.

Separate multiple regressions were performed for total duration of television exposure and for each category of content. For total amount of exposure, 1 to 2 hour group was used as a reference group and the rest of three exposure groups (i.e., no TV group, 0 to 1 hour group and more than 2 hours group) were entered in a single model. To assess the independent effect of each category of content, additional regressions were performed, including all 3 content categories in a single model, while adjusting for the

same control variables. In each of these models b (unstandardized regression coefficients) and B (standardized regression coefficients) were calculated.

Total Amount of Television Exposure

Zero order correlations between infants' and toddlers' television exposure and their subsequent academic skills showed that there was no relationship among total television exposure and three subsets of academic achievement tests (See Table 4.3). This result indicated that the relationships between television exposure and achievement scores may not be linear and that different levels of television exposure may result in cognitive differences. In order to test this, four total television exposure groups (i.e., no TV group, 0 to 1 hour group, 1 to 2 hours group, more than 2 hours group) were created.

As seen in Table 4.3, correlation results showed that there were significant relationships among these four groups and academic test scores. The group that watched no television had lower scores on the letter-word identification test and the applied problem test compared to the other three groups (r=-.09, p=.03; r=-.15, p=.007, respectively); and the 1 to 2 hours group had higher scores on all three subset tests than any other groups (letter word, r=.20, p=.002; passage comprehension r=.20, p=.002; applied problem .15, p=.003). The means and standard deviations of each academic subset test score for these four television exposure groups presented in the Table 4.7. also showed the 1 to 2 hours group had the highest mean scores of achievement scores among these four groups.

As seen in Table 4.8 after including covariates, OLS multiple regressions with the four total television exposure groups confirmed that different relationships emerged among groups with differing amounts of total television exposure. Infants and toddlers who were exposed to between 1 and 2 hours of television per day had higher scores on letter-word identification, passage comprehension, and applied problems than those who were not exposed to TV (b=7.44, p=.02; b=6.46 , p=.03; b=9.27, p=.01, respectively). Infants and toddlers who were exposed to between 1 and 2 hours of television per day also had higher scores than those who were exposed to between 0 and 1 hour of television per day (b= 8.02, p=.01).

To further explore this age effects, children were split into infant group and toddler group and the multiple regressions were tested separately for these two age groups. As seen in table 4.9, in the infant group, children who were exposed to between 1 and 2 hours of television were likely to have higher scores on applied problems than those who were not exposed to TV. Toddlers who were exposed to between 1 and 2 hours of television per day were likely to have higher scores on letter-word identification and passage comprehension than those who were exposed to between 0 and 1 hours of television per day and those who were exposed to more than 2 hours of television per day (See Table 4.10). These results may be the optimal amount of time for enhancing infants and toddlers' learning from television.

Table 4.7 Means and Standard Deviations of Academic Achievement Test Scores by Four Total Television Exposure Groups (N=513)

	Letter-word identification	Passage comprehension	Applied problems
	Mean (SD)	Mean (SD)	Mean (SD)
No TV group (n=129)	105 (19)	110 (15)	109 (16)
0 to 1 hours (n=121)	105 (19)	110 (15)	108 (14)
1 to 2 hours (n=114)	115 (7)	117 (13)	117 (14)
More than 2 hours (n=149)	108 (16)	111 (14)	109 (15)

Table 4.8. Unstandardized and Standardized OLS Regression Coefficients for Total Television Exposure Groups predicting Academic Achievement Test Scores (Time 2) (N=513)

	Letter-word Identification		
	b	SE	Beta
Predictors (Time 1)			
No TV group	-7.44*	3.25	-.19*
0 to < 1 hour group	-8.29**	2.88	-.20**
≥ 2 hour group	-4.17	3.16	-.11
R^2		.15	
	Passage Comprehension		
	b	SE	Beta
Predictors (Time 1)			
No TV group	-6.46*	2.91	-.19*
0 to < 1 hour group	-4.95	2.64	-.14
≥ 2 hour group	-4.11	2.82	-.12
R^2		.17	
	Applied Problem Test Scores		
	b	SE	Beta
Predictors (Time 1)			
No TV group	-9.27**	3.38	-.22**
0 to < 1 hour group	-4.76	2.84	-.11
≥ 2 hour group	-.85	3.28	-.02
R^2		.20	

Notes. *p < .05, ** p < .01, *** p< .001

Table 4.9. Unstandardized and Standardized OLS Regression Coefficients for Total Television Exposure Groups predicting Academic Achievement Test Scores (Time2) (Infant, n=314)

	Letter-word Identification		
	b	SE	Beta
Predictors (Time 1)			
No TV group	-4.81	4.02	-.14
0 to < 2 hour group	-3.32	3.43	-.08
≥ 4 hour group	.34	4.31	.01
R^2		.20	
	Passage Comprehension		
	b	SE	Beta
Predictors (Time 1)			
No TV group	-5.22	3.47	-.17
0 to < 2 hour group	-2.58	3.17	-.07
≥ 4 hour group	-.25	3.77	-.01
R^2		.17	
	Applied Problem Test Scores		
	b	SE	Beta
Predictors (Time 1)			
No TV group	-10.21*	4.34	-.27*
0 to < 2 hour group	-2.61	4.09	-.06
≥ 4 hour group	3.03	5.36	.06
R^2		.21	

Notes. *p < .05, ** p < .01, *** p< .001

Table 4.10. Unstandardized and Standardized OLS Regression Coefficients for Total Television Exposure Groups predicting Academic Achievement Test Scores (Toddler, n=199)

	Letter-word Identification		
	b	SE	Beta
Predictors (Time 1)			
No TV group	3.06	5.58	.03
0 to < 2 hour group	-12.78**	4.24	-.31**
≥ 4 hour group	-9.01*	4.11	-.26*
R^2		.23	
	Passage Comprehension		
	b	SE	Beta
Predictors (Time 1)			
No TV group	-2.79	7.39	-.03
0 to < 2 hour group	-8.12*	3.95	-.23*
≥ 4 hour group	-8.41*	3.67	-.28*
R^2		.18	
	Applied Problem Test Scores		
	b	SE	Beta
Predictors (Time 1)			
No TV group	-2.30	6.92	-.02
0 to < 2 hour group	-6.57	3.52	-.16
≥ 4 hour group	-4.56	3.66	-.13
R^2		.25	

Notes. *p < .05, ** p < .01, *** p< .001

Exposure to Specific Television Content

The associations between television exposure and academic achievement performance were hypothesized to vary depending on content, with the greatest adverse effects seen among children primarily exposed to child-noneducational content and adult content and the greatest positive effects seen among children primarily exposed to child-educational content. Contrary to this prediction, no relationship emerged linking exposure academic performance and exposure to specific television content (See Table 4.11).

However, because relationships between early exposure to different television content and subsequent academic performance may not be the same for different age groups, additional analyses tested for interactions between exposure to each type of television content and child age (child-educational content x age, child-noneducational content x age, adult content x age). As seen in Table 4.12, significant interaction effects between exposure to adult content and age emerged only in the case of passage comprehension test scores (b= -5.22, p= .02). For toddlers, children who were exposed to more adult content were likely to have worse passage comprehension scores 5 years later than those who were exposed to less adult content; on the other hand, infants who were exposed to more adult content were likely to have better passage comprehension scores 5 years later than their counterparts who were exposed to less adult content. There were no other age interaction effects for child-educational content and child-non-educational content. Figure 4.9 illustrates the interaction.

Table 4.11. Unstandardized and Standardized OLS Regression Coefficients of Exposure to Different Television Content on Achievement Test Scores (N=329)

	Letter-word Identification		
	b	SE	Beta
Predictors (Time 1)			
Child-educational content [a]	.24	.22	.07
Child-noneducational content [a]	.04	.24	.01
Adult content [a]	-.07	.26	-.02
R^2		.12	
	Passage Comprehension		
	b	SE	Beta
Predictors (Time 1)			
Child-educational content [a]	.02	.19	.01
Child-noneducational content [a]	.16	.20	.06
Adult content [a]	-.13	.24	.-04
R^2		.16	
	Applied Problem Test Scores		
	b	SE	Beta
Predictors (Time 1)			
Child-educational content [a]	.13	.22	.04
Child-noneducational content [a]	.27	.22	.08
Adult content [a]	-.13	.25	-.04
R^2		.18	

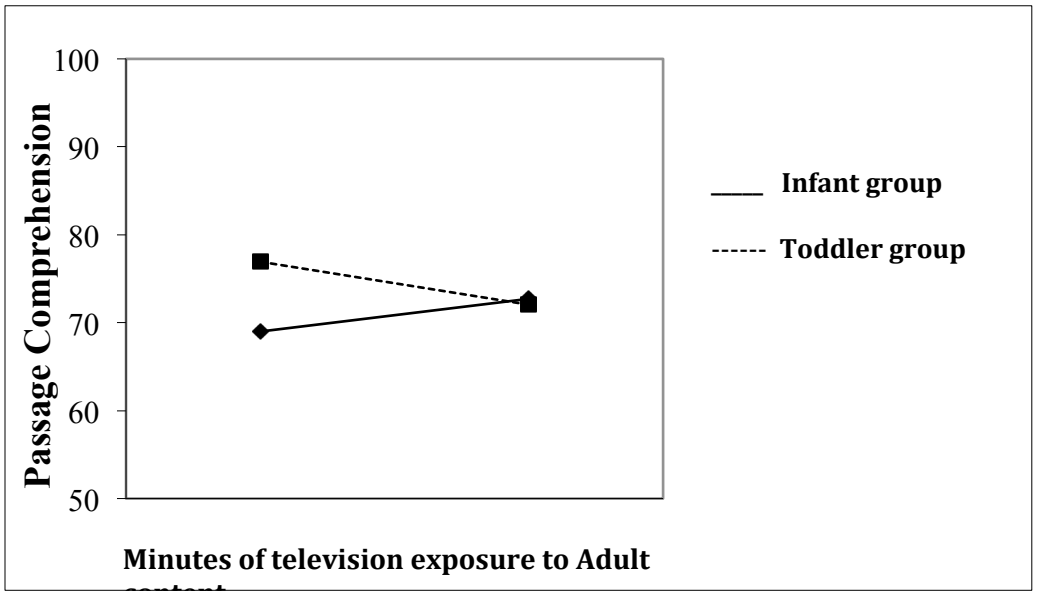
Notes. [a] These variables are modified using a square-root transformation.
Covariates are total television exposure, child age, child gender, income-to-needs ratio, parental education, HOME, presence of older siblings, presence of younger siblings, amount of time spent in daycare, and amount of time spent at home.

Table 4.12. Unstandardized and Standardized OLS Regression Coefficients of Interaction between Adult Content Exposure and Child Age Predicting Passage Comprehension Test Scores (N=329)

	b	SE	Beta
Main Effects			
Exposure to Adult content	-.56	2.24	-.02
Age	2.14	1.23	.12
Two Way Interaction Effects			
Exposure to Adult content * Age	-5.22*	2.24	-.15*
R^2		.17	

Notes. *$p < .05$

Figure 4.9. Interaction Effects between Exposure to Adult Content and Age on Passage Comprehension Test Scores



THE ROLE OF PARENTAL CO-VIEWING IN THE LONG-TERM EFFECTS OF TELEVISION EXPOSURE ON SUBSEQUENT COGNITIVE OUTCOMES

Multiple regression analyses were utilized to assess the role of parental coviewing in the long-term effects of exposure to specific television content on academic skills. The following predictors were included in the model: parental co-viewing of child-educational content, parental co-viewing of child-noneducational content, parental co-viewing of adult content. Three achievement scores were used as dependent variables. Child age, child gender, child ethnicity, family income-to-needs ratio, parental education, HOME, presence of older or younger siblings, amount of time spent in daycare, and amount of time spent at home were entered as covariates. Overall parental co-viewing minutes was used as a covariate. Thus, the association of total amount of parental co-viewing to cognitive outcomes was taken into account in the analyses.

To assess the independent effect of each category of content, all 3 content categories were included in a single model, while adjusting for the same control variables. Separate OLS multiple regressions were performed for different academic achievement scores. In each of these models b (unstandardized regression coefficients) and B (standardized regression coefficients) were calculated. The results of this regression model were found in Table 4.13.

As can be seen in Tables 4.13, there were significant relationships among parental coviewing of child-educational content and academic achievement scores (for passage comprehension, $b = 4.61$, $p = .04$; for applied problems, $b = 6.52$, $p = .01$). As children co-viewed of child-educational programs with parents before age 3, they have better

chance to have higher academic test scores 5 years later than children who did not coview with their parents. The model for co-viewing of child-educational content along with covariates accounted for 17% of the variance in passage comprehension standardized scores and 20% of the variance in applied problems standardized scores. However, there was no relationship among other parental coviewing contents and achievement scores.

As seen in Table 4.14, for infant group, parental coviewing of child-educational content only significantly associated with applied problem scores ($b = 9.75$, $p = .03$). Co-viewing of child-educational content along with covariates accounted for 26% of the variance in applied problem standardized score. As seen in Table 4.15, there was a marginally significant relationship between toddlers' coviewing of educational content with parents and passage comprehension scores ($b = 4.98$, $p = .09$). The model accounted for 18% of the variance in passage comprehension.

Table 4. 13. Unstandardized and Standardized OLS Regression Coefficients of Parental Coviewing Predicting Achievement Test Scores (Time2) (N=329)

	Letter-word Identification		
	b	SE	Beta
Predictors (Time1)			
Parental co-viewing of child-educational content	4.02	2.60	0.10
Parental co-viewing of child-noneducational content	-2.59	3.12	-0.07
Parental co-viewing of adult content	3.21	2.12	0.09
R^2		.14	
	Passage Comprehension		
	b	SE	Beta
Predictors (Time1)			
Parental co-viewing of child-educational content	4.61*	2.24	0.13*
Parental co-viewing of child-noneducational content	1.26	2.44	0.04
Parental co-viewing of adult content	1.63	1.90	0.05
R^2		.17	
	Applied Problem		
	b	SE	Beta
Predictors (Time1)			
Parental co-viewing of child-educational content	6.52*	2.62	0.16*
Parental co-viewing of child-noneducational content	-0.52	2.84	-0.01
Parental co-viewing of adult content	0.94	2.02	0.03
R^2		.20	

Notes. Covariates are overall parental co-viewing, child age, child gender, income-to-needs ratio, parental education, HOME, presence of older siblings, presence of younger siblings, amount of time spent in daycare, and amount of time spent at home; *$p < .05$

Table 4. 14. Unstandardized and Standardized OLS Regression Coefficients of Parental Coviewing Predicting Achievement Test Scores (Time2) (Infant group, n=156)

	Letter-word Identification		
	b	SE	Beta
Predictors (Time1)			
Parental co-viewing of child-educational content	0.45	3.34	0.01
Parental co-viewing of child-noneducational content	-4.57	4.28	-0.12
Parental co-viewing of adult content	0.99	2.94	0.03
R^2		.30	
	Passage Comprehension		
	b	SE	Beta
Predictors (Time1)			
Parental co-viewing of child-educational content	2.70	3.62	0.08
Parental co-viewing of child-noneducational content	0.15	3.46	0.01
Parental co-viewing of adult content	-0.41	2.84	-0.01
R^2		.24	
	Applied Problem		
	b	SE	Beta
Predictors (Time1)			
Parental co-viewing of child-educational content	9.75*	4.35	0.23*
Parental co-viewing of child-noneducational content	0.12	4.76	0.01
Parental co-viewing of adult content	2.02	2.92	0.06
R^2		.26	

Notes. Covariates are overall parental co-viewing, child age, child gender, income-to-needs ratio, parental education, HOME, presence of older siblings, presence of younger siblings, amount of time spent in daycare, and amount of time spent at home; *$p < .05$

Table 4. 15. Unstandardized and Standardized OLS Regression Coefficients of Parental Co-viewing Predicting Passage Comprehension Scores (Time2) (Toddler group, n=173)

	Letter-word Identification		
	b	SE	Beta
Predictors (Time1)			
Parental co-viewing of child-educational content	4.94	3.53	0.12
Parental co-viewing of child-noneducational content	-4.59	4.52	-0.11
Parental co-viewing of adult content	3.93	3.17	0.10
R^2		.17	
	Passage Comprehension		
	b	SE	Beta
Predictors (Time1)			
Parental co-viewing of child-educational content	4.94#	2.92	0.14#
Parental co-viewing of child-noneducational content	-0.76	3.56	-0.02
Parental co-viewing of adult content	2.76	2.79	0.09
R^2		.18	
	Applied Problem		
	b	SE	Beta
Predictors (Time1)			
Parental co-viewing of child-educational content	4.23	2.97	0.10
Parental co-viewing of child-noneducational content	-1.22	4.35	-0.03
Parental co-viewing of adult content	0.49	2.70	0.01
R^2		.20	

Notes. Covariates are overall parental co-viewing, child age, child gender, income-to-needs ratio, parental education, HOME, presence of older siblings, presence of younger siblings, amount of time spent in daycare, and amount of time spent at home; # < *.10*

Chapter 5: Discussion

This study investigates longitudinal associations between children's TV viewing from birth to 2 years of age and their academic test scores 5 years later. The goals of the study were as follows: (1) to provide comprehensive information regarding television viewing contexts likely to be operative in infancy and toddlerhood – what these children view, whom they co-view with, what they co-view, and what they are doing while the television is on (i.e., secondary activities); (2) to examine the long-term effects of early television exposure to different types of content (i.e., child-educational programs, child-noneducational programs, and adult programs) along with the effect of overall television exposure on subsequent cognitive outcomes; and (3) to assess the role of parental co-viewing in the long-term effects of exposure to child-educational content on academic skills. This chapter contextualizes the findings in reference to previous theoretical and empirical literature, discusses implications and notes limitations of the present study, and provides suggestions for future research.

THE CONTEXT OF TELEVISION EXPOSURE

It is clear that the American Academy of Pediatrics' recommendations of no screen time for children younger than 2 years and less than 2 hours of screen time for toddlers have not been widely heeded. Approximately half of the infants in this study were exposed to screen media on weekdays and on weekends (51%, 55%, respectively). Half of the toddlers were exposed to 2 or more hours of television on weekdays and

weekends (53%, 52%, respectively). There was no weekday/weekend difference for total television exposure. The lack of weekday/weekend difference may be due to the child age under investigation, which is supported by recent studies with infants and toddlers (Barr et al., 2010; Skouteris & McHardy, 2009).

Children under three were exposed to an average of 1 hour and 30 minutes of television and video/DVDs daily. Infants were exposed to an average of 1 hour of television per day, while toddlers were exposed to twice as much as infants, confirming that the daily exposure to television and video/DVDs during a child's first three years rose by approximately an hour per year before finally leveling off (Certain & Kahn, 2002; Jordan & Woodard, 2001). These findings are consistent with those of other studies focusing on exposure to television among infants and toddlers (Anderson et al., 1986; Lemish, 1987; Rideout & Hamel, 2006; Rideout et al., 2003; Zimmerman et al., 2007).

As regards television content exposure, there were weekday/weekend differences and age differences between exposure to television directed at children (child-educational, child-noneducational) and television intended for an adult audience. In particular, children were more likely to be exposed to child-directed television on weekdays and to adult-directed television on weekends. This may be because there are more child-directed programs on the air on weekdays (e.g., PBS). This may also be because parents can easily control their infants' program choices; however, as children get older, they may express preferences and help make decisions about which programs they watch.

As regards co-viewing, the results of this study show that 29% of parents report watching television or videos with their child. This finding is noteworthy in the context of the claim by producers of content for young children that their goal is to promote parent-child interaction. When infants and toddlers co-viewed with an adult, they were exposed mostly to adult programs (45% on a weekday, 42% on a weekend). These results imply that parents' viewing choices do appear to play a major role in determining very young children's exposure to adult programming. These findings counteract the common stereotype that children's exposure to inappropriate programs results from a lack of parental involvement. In fact, infants and toddlers are apt to be exposed to situation comedies, crime shows, shows, soap operas, sports, and news, because they are with their parents.

As regards the secondary activities that occur alongside television viewing, more than half of infants and toddlers were doing something else while they watched TV. The most common non-viewing behaviors were playing (30%), followed by social interaction (19%), eating (6.6%), and reading/being read to (1%). Several studies reported similar results (Lemish, 1987; Schmitt, 2001; Schmitt et al., 2003; Weber & Singer, 2004). This suggests that, at least for young children, TV may not interfere with play, and TV and play may not be alternative and mutually exclusive ways to spend time. Indirectly, these results also contradict a simple displacement hypothesis, according to which time spent viewing TV will be negatively correlated with time spent engaged in developmentally important activities such as play, spending time with parents, social interaction and

acquiring literacy skills. Furthermore, the displacement notion may be too simplistic to be applied to infants and toddlers.

TELEVISION EXPOSURE IN INFANCY AND TODDLERHOOD AND COGNITIVE OUTCOMES

Results from the preliminary analysis of nonsignificant correlation coefficients among total television exposure and three subsets of academic achievement tests, along with inconsistent study results regarding early television exposure and subsequent cognitive outcomes, indicated that the relationships between television exposure and achievement scores may not be linear, and that different levels of television exposure and exposure to different types of programs may result in different cognitive outcomes. First, OLS multiple regressions with four total television exposure groups (i.e., no TV viewing, 0 to 1 hour per day, 1 to 2 hours per day, more than 2 hours per day) showed that different relationships emerged, depending upon the amount of total television exposure. Children under 3 years who were exposed to between 1 and 2 hours of television per day had higher scores than those who were exposed to less (i.e., those who watched no TV at all and those who were exposed to between 0 and 1 hour). This relationship held true for both the infant group and the toddler group.

In the infant group, children who were exposed to between 1 and 2 hours of television per day were likely to have higher scores on applied problems than those who were not exposed to TV. In the toddler group, children who were exposed to between 1 and 2 hours of television per day were likely to have higher scores on letter-word identification and passage comprehension than those who were exposed to between 0 and

1 hour of television per day and those who were exposed to more than 2 hours of television per day. These results indicate that between 1 and 2 hours of television exposure per day may be the optimal amount of time for enhancing infants and toddlers' learning from television, which is also consistent with previous research with older children showing that the greatest positive effect on academic performance was present among children who watch moderate amounts of television (Newman, 1991; Potter, 1987; Williams et al., 1982). However, in order to confirm the exact amount of viewing time optimal in infancy and toddlerhood, more research with children in this age group is needed.

The associations between television exposure and academic achievement performance (letter-word recognition, passage comprehension, applied problems) were hypothesized to vary depending on television content, with the greatest adverse effects seen among children primarily exposed to child-noneducational content and adult content, and the greatest positive effects seen among children primarily exposed to child-educational content. This hypothesis has been partially supported. Initially, no relationship emerged linking academic performance and exposure to specific television content; however, when the interaction effects between exposure to each type of television content and age were tested, interaction effects between exposure to adult content and age emerged only in the case of passage comprehension test scores. Infants who were exposed to more adult content were likely to have better passage comprehension scores than their counterparts who were less exposed to adult content,

while toddlers who were exposed to more adult content were likely to have lower scores on the passage comprehension test than those who were less exposed to adult content.

This study's finding regarding the negative effect of viewing adult content on toddlers' cognitive skills, which is supported by previous studies (Barr et al., 2010; Tomopoulos et al, 2010; Wright et al., 2001; Zimmerman and Christakis, 2007), could be explained by social cognitive theory and the mental effort hypothesis, which holds that adult programs containing high levels of violence and adult language as well as humor beyond the comprehension abilities of infants and toddlers may hinder their ability to learn from screen media. The displacement hypothesis also presupposes negative effects of adult content on children's cognitive development and academic achievement. In this case, although television viewing itself does not clearly displace valuable activities, adult-audience programming may displace or interfere with the child's opportunities to spend time with parents, thus decreasing the amount of parent-child interaction (which is critical for children's cognitive and socio-emotional development). Considering that infants and toddlers are usually exposed to general- or adult-audience programs in the company of parents or other adults (St. Peters, Fitch, Huston, Wright, & Eakins, 1991), this lack of interaction is due not to the absence of parents, but to the possibility that adults watching television may be unresponsive and inattentive to their children. As a result, children may have fewer social and linguistic interactions with adults (Christakis et al., 2009). However, the unpredicted finding in the current study – namely, that exposure to adult content was linked to higher passage comprehension test scores for infants – warrants further investigation.

THE ROLE OF PARENTAL CO-VIEWING IN LEARNING FROM SCREEN MEDIA

The relationship between parental co-viewing and children's academic achievement performance was hypothesized to vary depending on content, with the greatest positive effects occurring for parental co-viewing of child-educational content. This hypothesis has been fully supported. Children ages 0 to 35 months who co-viewed child-educational programs with their parents before 3 years old were likely to have higher scores on the passage comprehension test and the applied problem test 5 years later than those who did not co-view child-educational programs with their parents. For the infant group, children who co-viewed child-educational content with their parents were also more likely to have higher applied problem test scores 5 years later. This is supported by several studies suggesting that parental scaffolding during television co-viewing positively impacts attention to and learning from television (Barr et al., 2008; Demers, 2008; Lemish & Rice, 1984).

IMPLICATIONS AND LIMITATIONS OF THE STUDY

This study provided comprehensive information about the television-viewing context in infancy and toddlerhood, and the complex family processes in which it is embedded. This study also confirmed that early exposure to different types of television content and total amount of television exposure were both related to subsequent cognitive outcomes. Parental co-viewing of child-educational content also played an important role in these relationships. The set of controls included in this study (i.e., child age, child gender, child ethnicity, income-to-needs ratio, parental education, HOME, presence of

older or younger siblings, amount of time spent in daycare, amount of time spent at home) included in this study is exceptionally powerful and thorough. In addition, when testing the relations between exposure to different types of television content, total television exposure was controlled; and when testing for the role of parental co-viewing of each type of television content, overall parental co-viewing was controlled. It seems reasonable to infer that the significant relations that emerged among television viewing and parental co-viewing and children's subsequent achievement are robust and probably represent true associations.

The present study benefited from the use of PSID-CDS data, which has a representative sample and comprehensive family characteristics, as well as time diary data. In addition, the longitudinal nature of the data allows consideration of the longitudinal effects of early screen exposure on later academic achievement scores. However, some limitations regarding these data must be noted. The first concern pertains to the sample size, and specifically for the subsample with information available on early exposure to television content and parental co-viewing of this content. Although the PSID dataset includes a nationally representative sample, the sample used in this study was limited by age (under three) and by the requirement that children had completed at least one CDS-1 time diary (Time 1) with a sufficient amount of codeable television data, and who also had complete data on at least one of the three subsets of academic achievement tests from Time 2. As noted in the attrition analysis (Chapter 4), these children differed from those with more complete data. Children retained in the TV

content subsample were more likely to be older and to have a lower family income-to-needs ratio, parents with less education, and younger siblings.

Having a small sample size may also result in failure to detect statistical significance (Bobko, 2001), which may in turn also decrease statistical power. In this study, for example, there were no relationships between early exposure to child-educational content and subsequent developmental outcomes. These non-significant results could be attributed to small sample size, as suggested in other studies (Barr et al., 2010; Tomopoulos et al., 2010; Zimmerman et al., 2007).

Second, correlations between viewing and achievement may be a function of other factors. The most well-established influences on both viewing and achievement include a host of demographic and family characteristics (e.g., education, income, and ethnicity), all of which probably represent variations in children's home environments (Huston & Wright, 1997; Wright et al., 2001). Such characteristics can be statistically controlled, but it is always possible that unmeasured variables account for all or part of the associations observed. It is impossible to include all kinds of covariates possibly linked to television exposure and cognitive skills.

Third, although time diaries, such as those used here, have been found to have a high degree of validity, the measure of early exposure to television is based on only two days (i.e., a weekday and a weekend), which may have led to measurement error. This problem should be readdressed in future research with more accurate assessments of early viewing.

Finally, although this study utilized longitudinal data with two time points, assessing the amount of exposure to different television content in infancy and toddlerhood and evaluating children's academic performances 5 years later, the correlational nature of these data precludes the ability to make causal inferences with certainty. In this study, inferences about causation were largely made based on knowledge of existing research in this area. Characteristics of a child and his or her family may affect not just the amount and the kind of television content the child was exposed to, but also the child's academic skills, creating a spurious relation between the two. For example, the observed relations between television exposure and academic performance could indicate that children with better reading or math skills have a tendency to choose different content than do those with poorer skills.

FUTURE RESEARCH AGENDA

The data for this study came from the first and second waves of the Panel Study of Income Dynamics (PSID) Child Development Supplement (CDS-I and CDS-II). Variables regarding television exposure and parental co-viewing were collected over a decade ago, and may not necessarily represent content that children are exposed to in the current environment. At the beginning of the 1990s, programs targeting infants and toddlers began to be produced, and since then various types of screen media targeting these age groups have been on an upsurge (e.g., the *BabyFirstTV* 24-hour channel, portable DVD players, smart phones, tablets, etc.). Content is always changing, both in terms of the types of programs newly aired and in the content of those continuously

produced. Even decades-old programs such as *Sesame Street* has changed formats (e.g., *Elmo's World*) and modified their lessons to address changes in children's needs (Linebarger et al., 2010). These new types of content, and the use of these new media, should be included in future studies.

This study reviewed only the role of parental co-viewing in regard to academic skill, but children co-viewed with their siblings as much as they co-viewed with their parents. If infants and toddlers had older siblings, they were less likely to co-view with their parents. Siblings no doubt influenced the types of programs to which children in this study were exposed. Those with older siblings tend to be drawn away from educational programs at earlier ages than are first-born or only children. Conversely, having a younger sibling helps prolong a child's viewing of educational preschool programs like *Sesame Street* (Pinon, Huston, & Wright, 1989). Future research needs to examine what role siblings may play in learning from television during infancy and toddlerhood.

Sesame Street, *Blue's Clues* and *Barney* have all benefited from careful design and have been rigorously tested to ensure educational benefits, at least for preschoolers (Anderson et al., 2001). By contrast, many infant-directed products have not yet been empirically tested, but make a number of explicit and implicit educational claims (Garrison and Christakis, 2005). Parents are clearly hungry for truly educational content for children younger than 2 years. More research is urgently required to determine whether it is realistic to produce genuinely educational content for infants and, if so, what it would be.

CONCLUSION

Television is now clearly part of the early educational environment. Exposure to television during infancy and toddlerhood is likely to have long-term consequences. These consequences are very likely to vary as a function of the content and context of the viewing experience. Content is more important than viewing time for infants and toddlers, and programs with age-specific educational curricula, coupled with parent-mediated viewing, could allow children to learn more efficiently and effectively. However, parental scaffolding may contribute more than program content to any early learning occurring during or resulting from co-viewing, given the fact that children in the sensory-motor stage have a limited cognitive ability to learn from screen media (Courage & Howe, 2010; Krcmar et al., 2007; Troseth, 2010).

Appendix A. Time Use Diary Sample

TIME	A	B	C	D	E	F	G	H	J
	What did your child do?	*Time Began*	*Time Ended*	*If watching TV, was that a tape or TV program?*	*If TV, video, computer games: What was the name of the (program/video/game/book) child was (watching/playing/reading)?*	*Where was the child?*	*Who was doing the activity with the child?*	*Who (else) was there but not directly involved in the activity?*	*What else was the child doing at the same time?*
Midnight	**1. Sleeping**	12:00	7:30			at home			
	Getting up	7:30	7:40			at home		mother	arguing
	Using the bathroom	7:40	7:45			at home			
	2. Eating breakfast	7:45	8:15			at home		mom, dad, cousin	watching TV
	3. Getting dressed for school	8:15	8:25			at home	mother	dad, cousin	talking
	Going to school	8:45	9:05			In car	mother		talking w/mother
	4. In school	9:05	3:15			school	teacher, other children		worked,played
	Going from school to YMCA	3:15	3:30			In car	Driver	other children	talking with other kids
	Playing basketball	3:15	5:00			YMCA	other children	counselor	talking w/other kids
5 PM.	Going home from YMCA	5:00	5:30			in car	father		talking
	5. Watching TV	5:30	6:00	TV program	Wishbone	at home	dad, cousin	mother	playing w/toys
	6. Eating dinner	6:00	6:25			at home	mom, dad, cousin		talking
	Reading book from library	6:25	7:00		Cat and the Hat	at home		mom, dad, cousin	
	Playing computer games	7:00	7:30		Oregon Trail	at home	cousin	mom, dad	
	Taking a bath/brushing teeth	7:30	8:30			at home			
	Watching TV	8:30	9:00	TV program	Simpsons	at home	cousin	mom, dad	hitting cousin
	Listering to bedtime story	9:00	9:20			at home	mom	dad	
Midnight	Sleeping	9:20	12:00			at home			

Appendix B. Definition of Secondary Activity Categories

What is the child doing at the time while watching TV?

Activity	Definition
No other activity	No other activity taking place at the same time (including relaxing, doing nothing, other passive leisure, receiving child care)
Social interaction	Affection Positive emotional affect Negative emotional affect Other/talking/conversations Conversations with household members Arguing/fighting with household members Arguing/fighting with non-household members
Play	
Creative play	Singing Acting in/ rehearsing for play Pretend play Board games/ Word puzzles/ educational games Social games Play with toys
General play	Unspecified play indoors Unspecified playing games Watched another person do leisure Other leisure activities
Active play	Football/ basketball Exercises Walking for pleasure/crawling Non-social dancing (ballet, modern dance) Jogging/ running Bicycling

(Secondary activity continues)

(Secondary activity continued)

Activity	Definition
Eating	Meals at home, away from home such as at a friend's home, or away from home such as at a restaurant
Others	
Naps	Naps & resting Night sleep
Reading/being read to	Reading/looking at books Reading other Being read
Chores	Laundry Pet are Other household chores Child care Waking up Non-medical care to adult

Appendix C. Television Coding Sheet

INTENDED AUDIENCE

Determine the audience that the program is primarily intended to reach.

Please note that coding for this category aims to capture the 'intended' audience, NOT among unintended audiences, these secondary audiences should not be considered within this category. For example, the movie, *Shrek*, was originally intended to target children but have contingently become popular among adults as well. In this case, the appropriate label for this movie is "Children (=0)" [NOT "General (=3)"].

Some programs are intended to appeal to both adolescents and adults. For example, the movie, *Spiderman* (2002) targets an adolescent audience as well as an adult audience. In this case, you should code UP in order to capture the older audience and label it "Adults (=2)" [NOT "Adolescents (=2)"; NOT "General (=3)"].

The program must fit into one of the following four labels (0~3) or to be coded as "Uncodeable(9)":

Value	Label	Definitions & Examples
0	**Children**	Aimed specifically at children, from pre-K through elementary school age. Ways to assess this: toys, food, or games are marketed based on the program; commercials that air during the program are child oriented; programs are originally aired in the mornings (in particular, Saturdays and Sundays) or in the afternoons (after school). ex. *Teletubbies, Sesame Street, Nick Jr.* shows, *Spongebob Squarepants, Spy Kids, Looney Tunes, Shrek, Ice Age, Mary-Kate & Ashley Olsen* videos (those produced between 1995~97; all titles listed in 1997 wave), *Care Bears, Inspector Gadget*

(Intended Audience continues)

(Intended Audience continued)

Value	Label	Definitions & Examples
1	**Adolescents**	Designed for an adolescent audience of middle- and high-school age. Usually depicts situations that this age group may experience, featuring characters that are of this age group. ex. *Saved by the Bell, Lizzie McGuire, The OC, Beverly Hills 90210, Dawson's Creek, Harry Potter*; *That's So Raven, Punk'd, Cribs, Making the Band,* sports shows such as Little League, *high-school cheerleading*
2	**Adults**	Consistently contains adult situations or language including, but not limited to, sexual innuendos and graphic violence. Dialogue, vocabulary, and plot tend to be complex. (Targeted to 'your parents' or the 18-34 demographic.) ex. *Law and Order, CSI, Desperate Housewives, Lost, Swan, Friends, Everybody Loves Raymond, Seinfeld, SNL, Real World, American Idol, NFL, NBA* games (most sports shows), news, award shows, culture/science/history documentaries
3	**General**	Consciously designed for all audiences; intended to appeal to a wide-range of audience. Appropriate for children to watch but simultaneously fun for adults to watch as well. The level of violence, sex or language is usually mild. Often focuses on the adventures of a family. Usually is a sit-com or drama format. ex. *Seventh Heaven, Full House, Cosby Show, Leave it to Beaver, Bernie Mac Show, The Waltons, Little House on the Prairie, Brady Bunch, Sound of Music, Free Willie, America's Funniest Home Videos, Annie, Miracle on 34th St., Jack Frost, Mouse Trap, Honey I Shrunk..., MLK Parade,* nature docus, home videos
9	**Uncodeable**	It is impossible to accurately discern the intended audience from the information provided.

CURRICULUM

Determine the nature of the curriculum that the program is intended to provide.

Some programs tend to have multiple curricular goals. In such cases, assess and code for the PRIMARY goal or focus of the program. For example, *Sesame Street* teaches lessons to enhance both children's pro-social values as well as their school readiness skills. However, the pro-social messages are embedded within lessons that teach school readiness skills, such as learning shapes and numbers. That is, the school-readiness lessons are the main focus. In this case, the appropriate label for this program is "School Readiness (=2)" [NOT "Pro-Social (=1)"].
Also note that we are assessing the 'general, overall' curricular of the program itself. That is, we are assessing only that curriculum which consistently makes up a major part of the regular formula of the program. You should NOT focus on 'irregular, occasional happenings' of one or two specific episodes or scenes.

The program must fit into one of the following six labels (0~5) or be coded as "Uncodeable (9)":

Value	Label	Definitions & Examples
0	**No Curriculum**	Does not have a salient or consistent goal to teach or to present subject matter in an informative manner. Is not designed to achieve any of the below curricular goals. Usually for general entertainment. ex. *Die Hard, Good Morning America, Real World, Monday Night Football, CSI, Law & Order, Looney Tunes, Babe, News*
1	**Pro-Social**	Primary goal is to promote appropriate and positive values, attitudes, behaviors, or inter-personal interactions (family, friendships, sharing, cooperation, tolerance of cultural diversity, don't drink and drive, safe sex). Intends to teach a moral lesson. Includes programs with religious messages. *ex. Barney and Friends, Clifford: The Big Red Dog, Mr. Rogers, Seventh Heaven, Full House, Dragon Tales, Cosby Show, Charlotte's Web, David and Goliath, Televised church services*

(Curriculum continues)

(Curriculum continued)

Value	Label	Definition & Examples
2	**School Readiness**	Primary goal is to enhance children's perceptual and cognitive skills and to prepare them for school. Teaches counting, basic math, and reading. Generally aimed at pre-school children. ex. *Sesame Street, Reading Rainbow, Dora the Explorer, Between the Lions* *(Curriculum continues)*
3	**Extended Academic Learning**	Primary goal is to teach advanced skills beyond the elementary-school level. Usually intended for higher education or to supplement learning for people in middle-school or above. Teaches advanced English, non-English languages, political science, economics, psychology, etc. *ex. PBS language programs, Distance-learning programs* *)*
4	**Informal Learning**	Primary goal is to deliver information that may assist in developing skills for certain leisure activities, such as knitting, sewing, painting, pottery, gardening, home building/renovation, auto repair, fishing, cooking, fashion, exercise, etc. Generally presented in a format that makes it easy for the viewer to follow along. Usually classified under the *Genre* of "Do-It-Yourself/Hobbies (=3)." Usually intended for adults. ex. *Emeril Live, Trading Spaces, Martha Stewart, What Not To Wear*
5	**Culture/ Science/ History**	Primary goal is to inform about specific cultures; scientific facts; historical events, landmarks, or people; etc. Sometimes it does not intend to literally "teach a lesson" but can enhance knowledge obtained in school. Usually classified under the *Genre* of "Documentary (=16)." Programs can be intended for adults or children. ex. documentaries on *History* and *Discovery Channels*, *Magic School Bus, Bill Nye the Science Guy, Zoom*
9	**Uncodeable**	It is impossible to accurately discern the curriculum from the information provided.

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