THE EFFECT OF BACKGROUND TELEVISION ON ATTENTION AND LEARNING IN 3-YEAR-OLD CHILDREN

STEPHANIE GOULDING

The Effect of Background Television on Attention and Learning in 3-Year-Old Children

by

© Stephanie Goulding

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Abstract

The impact of background television on attention and learning activities (reading a book and assembling a puzzle) was investigated in the present study. In the presence of background television, three-year-olds looked off-task more frequently and for a greater duration than preschoolers who did not experience the background television, indicating that background television distracted the three-year-olds from the tasks. However, the presence of background television did not influence all measures of performance; only one out of the four measures of performance (verbal recall of story detail) suffered in the presence of background television. Additional variance in task performance was explained by executive functioning. Overall, the study gives some insight into the effect of background television on three-year-olds' performance.

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The Effect of Background Television on Attention and Learning in 3-year-old Children

Television plays a prominent role in the lives of young children. According to a nationally (i.e., USA) representative telephone survey, approximately 99% of young children live in a home in which there is at least one television set, with the majority of homes possessing two or more sets (Rideout & Hamel, 2006; Rideout, Vandewater, & Wartella, 2003; Vandewater, Rideout, Wartella, Huang, Lee, & Shim, 2007). Forty-three percent of children between three- and four-years of age have a television in their bedroom (Vandewater et al., 2007). Moreover, 32% of children under the age of six live in a household in which the television is on most of the time or always, regardless of whether someone is actually watching it (Rideout & Hamel, 2006). A further 21% live in households with the television on half of the time (Rideout & Hamel, 2006). Given that television is so common in the households of young children, it is not surprising that they spend a considerable amount of time engaged in television viewing. Reports of the amount of time children under the age of six spend watching television range from 1.19 hours (Rideout & Hamel, 2006) to 4.0 hours daily (Lee, Bartolic, & Vandewater, 2009). However, it should be noted that the variation in viewing time among children is large, ranging from zero to approximately six hours per day in a single study (Zimmerman & Christakis, 2005).

Preschool age children are not only exposed to television at home, but also in daycare settings. Children in daycare are exposed to 1.39 hours per day in home-based daycares and .36 hours per day in centre-based daycares (Christakis, Garrison, &

Zimmerman, 2006). Combined with the parental reports of viewing at home, a preschool age child may watch as much as 5.39 hours of television per day. Considering most parents are unaware of the exact time spent at activities in their child's preschool, it is unlikely that they have included time spent viewing at preschool within their estimates of television viewing time and, thus, parental reports given in studies may be inaccurate.

Television also accompanies many of the daily activities of young children. For example, 53% of children under six-years-old often consume snacks or meals in front of the television (Rideout & Hamel, 2006). Furthermore, television is now a common element of bedtime for some children. Thirty-seven percent of the children who have televisions in their bedroom go to bed with the television on half of the time or more (Rideout & Hamel, 2006). These data reveals that television is not just a primary activity for young children, but also a secondary activity that occurs in conjunction with many other daily activities.

Research findings suggest that children's television viewing habits are often formed early in life and are reinforced over time, such that individual differences in television viewing habits persist from preschool into early childhood and beyond (Huston, Wright, Rice, Kerkman, & St. Peters, 1990; Lee et al., 2009). For example, Huston et al. assessed the television viewing patterns of three- and five-year-old children. The same children were assessed again when they were five- and seven-years-old. Huston et al. found children who viewed a large amount of television at the time of the initial assessment tended to view large amounts of television at the two-year follow-up. The same was true for the children who watched little television; they continued watching small amounts of television. These correlations suggest that the television viewing habits

of young children remain stable for at least two years. In addition, Huston et al. noted that over the two years, children continued to demonstrate a preference for television programs within the same category as they initially preferred. For instance, children who watched educational programs at three- and five-years-old continued to watch a high proportion of educational programs at five- and seven-years-old. The same was true for the other program categories of entertainment, comedy, and action adventure (Huston et al., 1990). This stability in viewing patterns may reflect the influence of the family environment, such that some home environments may promote a high level of television viewing of certain type of programs while others do not (Huston et al., 1990).

Television exposure can be classified as foreground or background. In general, foreground television consists of shows that are largely comprehensible to young children (Anderson & Pempek, 2005). That is, the television show is directed towards young children and readily captures and holds their attention. With foreground television, the child's primary activity and focus of attention is the television program itself. Background television, on the other hand, involves programs that are normally not comprehensible to young children (Anderson & Pempek, 2005) and includes shows targeted at older audiences. Background television provides visual and auditory stimulation that is external to the child's task at hand, such that the child is normally engaged in an activity with the television providing stimulation that has the potential to distract from the ongoing activity. An example of background television would be when a young child is sitting in a room putting together a puzzle and the News is on the television. The child may look to the television, but it is not his or her primary focus. The distinction between foreground and background television, however, is not absolute.

Background television can easily become foreground television if some feature of the television program captures and holds the child's attention. The opposite is also true. Foreground television can become background television when the program loses the child's attention and the child begins to engage in other activities. Anderson and Pempek (2005) suggest that background and foreground television are likely to have different effects on young children: foreground television may be beneficial as it could potentially provide learning opportunities, whereas background television is more likely to distract from a learning task.

The Consequences of Television Viewing

From the time television was introduced, there has been a considerable amount of research conducted on the potential benefits and harms of watching television (for a review see Pecora, Murray, & Wartella, 2007). In recent years, focus on the research examining the positives and negatives of television viewing has exploded due to the considerable amount of exposure to television today's young children receive. In 2001, based on mostly indirect evidence, the American Academy of Pediatrics (AAP) recommended that children under two years not be exposed to television at all and that young children in general, only be exposed to a hour or two of quality (i.e., educational) television per day. The research on the potential benefits and harms associated with television viewing continues today, with the research illuminating both positive and negative consequences.

Possible Benefits of Television Viewing

One of the most commonly cited reasons for allowing children to watch television is that parents see it as an educational tool (He, Irwin, Bouck, Tucker, & Pollett, 2005)

and there is evidence to support this view. Studies investigating the impact of children's educational shows, such *Sesame Street* and *Blue's Clues*, have demonstrated that young children have the ability to learn from television (Ball & Bogatz, 1970; Linebarger, 2001; Linebarger, Kosanic, Greenwood, & Doku, 2004). For example, children seem adept at learning vocabulary from television (Anderson & Pempek, 2005; Krcmar, Grela, & Lin, 2007; Linebarger & Walker, 2005). Take for instance, Linebarger and Walker's study of infants' television viewing habits and language development. Television viewing diaries were completed by parents every three months from six months to 30 months of age. Linebarger and Walker then compared the shows watched to various measures of language development. At 30 months, watching programs such as *Dora the Explorer, Blue's Clues,* and *Dragon Tales* was associated with larger vocabularies compared to not watching these shows, with effect sizes ranging from $d = .49$ to $d = .55$. Moreover, viewing certain educational shows as a young child has been found to predict higher levels academic achievement later in life (Anderson et al., 2001; Huston et al., 2001; Zill, 2000).

These educational benefits should be interpreted with caution as research also shows that children under three years of age do not learn as well from video as they do from individuals who are present with them (Krcmar et al., 2007; Kuhl, Tsao, & Lui, 2003). This "video deficit" (Anderson & Pempek, 2005) is most commonly observed in infants and toddlers and tends to decrease with age. For instance, Barr and Hayne (1999) observed that 12- and 15-month-old infants were unable to imitate a multistep sequence from a video demonstration, whereas 18-month-old participants in the same study successfully imitated under those circumstances. In addition, repetition of a video

depicting a sequence can promote imitation of that sequence in 12- to 21-month-old infants, virtually eliminating any difference between the infants that viewed the demonstration live and those that viewed the videotaped demonstration (Barr, Muenterner, Garcia, Fujimoto, & Chávez, 2007). Secondly, the content of the shows viewed is very important in determining the impact of viewing, as cartoons and other non-educational shows have been found to have a negative impact on learning and school achievement (Hancox, Milne, & Poulton, 2005; Linebarger & Walker, 2005). Linebarger and Walker found viewing *Teletubbies* and *Barney* to be associated with lower scores on measures of vocabulary development in 30-month-olds, with effect sizes ranging from $d = .45$ to $d = .73$. As well, children who are at risk to develop poor reading skills seem to benefit the most from educational programs, with middle class children showing less benefit (Linebarger et al., 2004).

Television programs have also been reported to teach young children prosocial behaviors (Friedrich & Stein, 1973; Friedrich & Stein, 1975; Rideout & Hamel, 2006). In fact, 66% of parents of children under six years indicate that the behaviors most often imitated by their children from television are prosocial behaviors such as sharing or helping (Rideout & Hamel, 2006). Experimentally, Friedrich and Stein (1973) found that preschool children who viewed approximately 30 minutes of *Mister Rogers' Neighborhood* exhibited more prosocial behaviors, such as increased cooperation with other children, than the children in any of the other viewing conditions. Thus, it seems that children can learn more than just vocabulary from television, they can also learn a variety of new behaviors.

Possible Harmful Consequences of Television Viewing

Perhaps the most commonly cited and best-documented negative factor associated with television viewing is that many children who view large amounts of aggressive content also show more aggressive behavior in a variety of settings. A considerable body of experimental and correlational research, dating back to the 1960s, has shown a relationship between television viewing and higher rate of aggressive behavior (e.g., Bandura, Ross, & Ross, 1963; Hopf, Huber, & Weiß, 2008; Huesmann, Moise-Titus, Podolski, & Eron, 2003). The majority of the research linking the viewing of aggressive television content to higher rates of aggression is correlational in nature (e.g., Hopf et al., 2008; Huesmann et al., 2003; Johnson, Cohen, Smailes, Kasen, & Brook, 2002), which only highlights a positive relationship between television viewing and aggressive behavior. This research lacks manipulation and control of exposure to aggressive television and thus, cannot control many extraneous factors that may influence the relationship, such as trait aggression, previous exposure to violent television and other media, and other personal experiences. For these reasons, correlational studies do not permit causal inferences. Nevertheless, the experimental studies that have systematically manipulated exposure to violent and aggressive television content (e.g., Bandura et al., 1963; Bushman, 1995; Grãna et al., 20004) do allow for attributions of causality and have demonstrated that viewing aggressive television material can increase aggressive behavior in some children. However, these experimental studies paint a slightly different picture of the relationship between television viewing and aggression. The experimental studies have demonstrated that not every individual displays increased levels of aggression in every situation. Rather, factors such as trait aggression mediate this

relationship (Bushman, 1995; Celozzi, Kazelski, & Gutsch, 1981; Friedrich & Stein, 1975). The distinction between correlational and experimental research is an important one and plays a large role in the controversy surrounding many of the supposed consequences of television viewing.

Additionally, the content of the television programs watched may also play a role in the aggression-television relationship. As noted above, Friedrich and Stein (1973) found that viewing *Mister Rogers' Neighborhood* increased prosocial behaviors. Similarly, they pointed out that preschoolers who viewed aggressive cartoons, such as *Batman* and *Superman*, produced more instances of aggressive behavior toward other preschool children (Friedrich & Stein, 1973). Thus, two different types of television programs have the ability to produce completely opposite effects in preschoolers. Overall, it seems that television viewing may explain a small, but significant, portion of aggressive behavior (Singer, Miller, Guo, Flannery, Frierson, and Slovak, 1999) and individual differences help explain why some people do show elevated levels of aggression in response to television viewing, whereas others do not.

A second major concern about viewing large amounts of television is that it might be associated with attention problems. Specifically, an increase in time spent viewing television in early childhood is associated with an increase in later incidents of symptoms of attention-deficit hyperactivity disorder (ADHD) (Christakis, Zimmerman, DiGiuseppe, & McCarty, 2004; Landhuis, Poulton, Welch, & Hancox, 2007; Özmert, Toyran, & Yurdakök, 2002). Although the issue had been previously noted by other researchers (e.g., Levine & Waite, 2000; Özmert et al., 2002), the relationship received considerable attention when the media reported on Christakis et al.'s study.

In Christakis et al.'s (2004) study, data from the National Longitudinal Survey of Youth was utilized to test the relationship between the time American children spent viewing television at ages one and three years and attention problems at seven years of age. Christakis et al. concluded that the amount of time spent viewing television at both one and three years of age was significantly related to the development of later attention problems. More specifically, they noted than an increase of one standard deviation (M = 2.2 hours, SD = 2.91) in viewing time per day at one-year-old increases the probability of having attention problems at seven years by 28%. Though, the research on television and attention problems has received considerable attention, it should be noted that other research indicates there is no association between television viewing and subsequent attention problems (e.g., Foster & Watkins, 2010; Obel et al., 2004; Stevens & Mulsow, 2006). Moreover, considering the correlational nature of Christakis et al.'s (2004) study, they failed to account for the likelihood that other factors, such as family income and maternal education, that could account for the relationship between television viewing and attention problems. To address this issue, Foster and Watkins (2010) reanalyzed the data used by Christakis et al. in their controversial study, but controlled for maternal educational achievement and child's poverty status in early life. While they found a modest relationship between television viewing at one- and three-years-old and attention problems at seven years, the relationship existed only for those children that watched seven or more hours per day. This amount exceeds the average viewing time of children in this age group by approximately five hours per day. Moreover, any relationship between television and subsequent attention problems disappeared after adding maternal educational achievement and child's poverty status to the models (Foster & Watkins,

2010). An alternative explanation for the relationship between viewing large amounts of television and attention problems is that these children might enjoy watching television more than their counterparts without attention problems (Acevedo-Polakovich, Lorch, & Milne, 2007). This illustrates Christakis et al.'s failure to rule out alternate explanations. Additionally, only five items were utilized by Christakis et al. to assess whether participants had attention problems. These five items belong to the hyperactivity scale of the Achenbach Child Behavior Checklist (Achenbach & Rescorla, 2001). Parents were asked to rate whether their children often, sometimes, or never displayed the following behaviors: difficulty concentrating, easily confused, impulsive, trouble with obsessions, and restlessness (Christakis et al., 2004). The responses to these five items are not sufficient to determine whether attention problems exist as they lack the validity necessary to measure and determine attention problems.

Television viewing has also been found to have other potential negative impacts on attention. For example, it has been argued that viewing fast-paced television shows may lead to a reduced ability to attend to various age-appropriate games and activities in four- and five-year-olds (Geist & Gibson, 2000). It is important to note, though, that Geist and Gibbson did not quantify what was meant by a faced-paced television show. They also made no attempt to clarify which elements of the programs lead the children in the fast-paced program condition to spend less time on-task compared to the slow-paced group. So it is possible that characteristics other than pace of the shows, such as the story and content of the program, affected the results. Cooper, Uller, Pettifer, and Stolc (2009) have also found that television viewing influences attention. In their study of four- to seven-year-olds, the ability to visually orient to stimuli was affected by only 3.5 minutes

of television exposure. The children in the fast-paced program condition were slower to orient and made more errors when orienting than did the children who viewed the slow-paced television program. In addition to affecting attention, higher amounts of television viewing have been linked to lower scores on measures of cognitive functioning, such as reading recognition and comprehension and memory (Zimmerman & Christakis, 2005).

Additionally, various other negative cognitive outcomes have also been found to be related to television viewing. Concern has been raised that television viewing takes time away from other important activities, such as reading (Anderson & Evans, 2001). While preschoolers cannot read themselves, having an adult read to them is a critical activity as it promotes literacy development (Bialystok, 1995; Justice & Ezell, 2000). For children under six-years-old, increasing amounts of television viewing are associated with less time being read to by parents (Rideout et al., 2003; Vandewater, Bickham, Lee, Cummings, & Rideout, 2005). There is also a concern that television viewing reduces physical activity and promotes a sedentary lifestyle. Numerous studies demonstrate a significant positive relationship between television viewing and obesity in older children (Danner, 2008; Delmas et al., 2007; Raynor, Phelan, Hill, & Wing, 2006). Given the stability of television viewing patterns, it is critical to avoid beginning a sedentary lifestyle comprised of a significant amount of time viewing television as a preschooler.

In infants and young children, the presence of television has been observed to reduce the amount of time spent engaged in toy play (Courage, Murphy, Goulding, & Setliff, 2010; Schmidt, Pempek, Kirkorian, Lund, & Anderson, 2008). Children as young as six months will look less at toys in the presence of television compared to when the television is off (Courage et al., 2010). Not only does television reduce the duration of

play, it distracts young children from toy play. Eighteen-month-olds were observed to look up from toys they were engaged with more frequently when the television was on versus off (Courage et al., 2010). This indicates that television disrupts play and distracts young children from this important activity. The distracting effects of television are further illustrated by Schmidt et al.'s (2008) finding that 12-, 24-, and 36-month-olds demonstrated a 25% decrease in the length of their focused attention episodes to toys. Focused attention is an intensely engaged and highly concentrated form of attention and is believed to indicate the processing of information (Pribram & McGuiness, 1975; Ruff & Lawson, 1990). Considering the importance of play to numerous aspects of cognitive development (see Power, 2000), television's ability to reduce the duration of play and focused attention during play is a great concern.

Summary of the Consequences of Television Viewing

Television has the potential to both benefit and harm young children. The majority of the benefits of television viewing center around television being an educational tool. This is true for the benefits of vocabulary learning and prosocial behavior. The potential harms of television viewing are more diverse and include increasing aggressive behavior, increasing likelihood of attention problems, displacing important activities, and reducing time spent at and quality of toy play. However, it seems that to adequately address the issue of whether television is good or bad, the content of the programs viewed, not television viewing in general, is important (Anderson et al., 2001; Wright et al., 2001). Depending on the programs watched, the effects of viewing will differ. Viewing violent shows, for example, may be associated with an increase in aggressive behavior. Conversely, viewing programs with educational content

may promote vocabulary development in preschoolers. Age of viewing may also be a factor in determining the outcome of television viewing (Christakis & Zimmerman, 2006), as age plays a role in children's ability to learn from television. Regardless of what the research says, it is important to keep in mind that it is ultimately parents' perceptions of television that influence whether or not children watch television and the shows they view when they do watch. Considering parents seem to be spilt in their beliefs of the potential positive and negative consequences of television viewing (Rideout, 2007; Rideout & Hamel, 2006), it is paramount to gather evidence demonstrating the effects of television on young children to help parents make informed decisions about television viewing for their child.

Attention

Attention plays an important role in many learning situations (Ruff & Lawson, 1990) and in keeping behavior organized in the face of simultaneously competing stimuli (Ruff, Capozzoli, & Saltarelli, 1996). There are many ways to define and conceptualize attention (Posner & Boies, 1971), as it is a multifaceted construct that is composed of many behavioral and neurological processes (Colombo & Cheatham, 2006; Posner & Boies, 1971; Ruff, 1986). In general, many of the processes that represent attention share the common theme of "selection" (Colombo & Cheatham, 2006). That is, attention is the ability to selectively focus on one event while simultaneously ignoring other events that are occurring. Thus, the mechanisms of self-control are an important component of attention (Posner & Rothbart, 2000). However, attention is much more than just selection, as it also involves the orientation to stimuli, the investigation of stimuli, and the processes that underlie volitional control of attention. Given the information supporting

the vastness of the construct of attention, it is not surprising that it is difficult to provide a precise definition of attention.

The Development of Attention

Despite the difficulty in defining attention, several frameworks describing its development have been proposed. These frameworks often focus on specific attentional processes and the neural mechanisms responsible for these processes. Ruff and Rothbart (1996; 2001) and Colombo (2001) provide examples of such frameworks. In Ruff and Rothbart's framework, the focus is mostly on the development of the processes of attention, their behavioral expression, and the social and cognitive implications of these processes. Colombo's framework is consistent with Ruff and Rothbart's conceptualization of attention, but he provides more emphasis on the neurological aspects of attention than do Ruff and Rothbart. Considered jointly, these two frameworks provide a reasonable perspective for understanding the development of attention.

According to Ruff and Rothbart (1996; 2001), the processes of attention are controlled by two major attention systems: the orienting/investigative system and the higher level controls system. Attention is dominated by the orienting/investigative system in the first year of life. This system matures fairly early in the first year and is responsible for the orientation to and the examination of stimuli. The higher level controls system, on the other hand, begins to appear at the end of the first year and matures gradually over the preschool years. This system is endogenously directed and underlies goal-oriented attention and control of complex activity (Ruff & Rothbart, 1996; 2001).

In contrast, Colombo (2001) breaks attention down into four specific systems: arousal/alertness, visuospatial orienting, object recognition, and endogenous attention. Each of Colombo's systems corresponds to a specific function of attention. The first system of arousal/alertness can be conceptualized as a state of readiness or preparedness to attend. These functions are observed in both Ruff and Rothbart's (1996; 2001) orienting/investigative system and higher level controls system. In the orienting/investigative system, arousal/alertness would be more of an involuntary response to stimulation. Arousal/alertness in the higher level controls are also largely involuntary, but may also be in response to internal motivation. Colombo's second system of attention is visuospatial orienting. This system is equivalent to the orienting portion of Ruff and Rothbart's orienting/investigative system. The third system proposed by Colombo is object recognition. As suggested by its name, this system is responsible for the identification of features of objects for the purpose of their identification. The functions of the object recognition system are subsumed under Ruff and Rothbart's orienting/investigative system. The final system in Colombo's framework for the development of attention is endogenous attention. This system permits internal motivation to guide attention and allows the child to inhibit or maintain attention to a stimulus. Ruff and Rothbart's higher level controls is equivalent to Colombo's endogenous attention and both are systems of executive attention. In the first two years of life there are several transitions that lead from orienting/investigative dominated attention to attention governed by the higher level controls system (Ruff & Rothbart, 1996; 2001). These transitions occur at approximately 2, 9 to 12, and 18 to 24 months. The same is true in Colombo's framework, with the arousal/alertness, visuospatial

orienting, and object recognition systems setting the stage for the development of endogenous attention.

More recent neurological frameworks have typically followed the conceptualization described by Ruff and Rothbart (1996; 2001) and Colombo (2001). For example, Richards (2008) also included arousal, spatial orienting, object recognition, and executive attention in his framework, though he utilizes slightly different terms. However, Richards stresses the importance of arousal in visual attention. Arousal is believed to be involved in all aspects of attention, from orienting to maintaining attention, and can operate across modalities. Richards suggests that a general arousal system guides attention. Neural connections between the mesencephalic reticular activation system and the cortex are responsible for arousal. The noradrenergic and cholinergic neurotransmitter systems are also involved in arousal and enhance processing within the cortex. This means that the general arousal system has the ability to enhance activity in the brain regions associated with attention. So, in Richards view, arousal is key in the deployment of attentional resources and in the processing of information gained through visual attending.

Despite spending very little time alert (Wolff, 1987), newborns exhibit patterns of looking that are both selective and organized. At approximately two to three months of age, infants' duration of alertness increases (Wolff, 1987) and the ability to achieve and maintain an alert state develops (Colombo, 2001). For infants less than two- or three-months-old, external events representing the lower-level mechanisms initiate arousal (Wolff, 1965). After the first couple of months of life, alertness gradually becomes attributable to more internal sources. Two ascending brainstem systems seem to be

critical to alertness. The first, and perhaps most important, is the noradrenergic system (Aston-Jones, Rajkowski, Kubiak, & Alexinsky, 1994; Usher, Cohen, Servan-Schreiber, Rajkowski, & Aston-Jones, 1999), which originates in the locus coeruleus and is linked to anticipatory readiness (Aston-Jones et al., 1994; Usher et al., 1999). The second ascending pathway of importance to alertness is the cholinergic pathway, which originates in the brainstem's pontine tegmentum (Robbins et al., 1989; Sahakian et al., 1993; Sarter, 1994). This pathway is suspected to be involved in cortical arousal and the sleep wake cycle (Robbins et al., 1989; Sahakian et al., 1993; Sarter, 1994). Additionally, at this time there is maturation of components of the visual system. In particular, the retina undergoes important developments that enable the infant to recognize objects. As well, the pathways that connect the visual system mature and allow attentional processes to gain greater control of eye movements (Lewis, Maurer, & Brent, 1989). This now permits experience to play a key role in determining attentional focus (Ruff & Rothbart, 1996; 2001). For example, selective visual attention is strongly influenced by the novelty of objects and events. The orienting/investigative system is dominant at this point (Ruff & Rothbart, 1996; 2001).

In the period between three and nine months, the orienting/investigative system is supported by further maturation of the visual system and maturation of the posterior orienting network (Ruff & Rothbart, 1996; 2001). Within this time period, the neural mechanisms that support visuospatial orienting become well established (Colombo, 2001). Visuospatial orienting includes the processes of engaging visual attention, disengaging visual attention, and shifting visual attention from one location to another, which are mediated by the pulvinar of the thalamus, the posterior parietal lobe, and the

superior colliculus, respectively (Posner & Peterson, 1990). Each of these components takes a different developmental course, with all being fairly well established by approximately six months (Colombo, 2001).

Visual attention undergoes another developmental transition at around nine to 12 months (Ruff & Rothbart, 1996; 2001) when rudimentary inhibition (Diamond, 1985; 1998) and intentionality of action are first observed. These abilities are due to the emerging motor skills and changes occurring in the lateral region of the prefrontal cortex (Diamond & Goldman-Rakic, 1989). It is this point near the end of the first year of life that both Ruff and Rothbart and Colombo (2001) indicated to be the beginning of executive attention.

According to Colombo (2001), endogenous attention permits internal motivation to guide attention and the ability to inhibit or maintain attention to a stimulus. Areas located in the frontal lobe, such as the anterior cingulate, the frontal eye fields, and the dorsolateral prefrontal cortex, mediate executive attention (Funashi, Bruce, Goldman-Raki, 1989; Guitton, Buchtel, & Douglas, 1985; Posner & Peterson, 1990). Frontal areas of the brain possess a bidirectional link with many other areas of the brain including the areas responsible for visuospatial orienting and object recognition. This allows frontal regions to receive input from these lower brain regions and to coordinate them (Colombo, 2001).

The executive attention system undergoes consolidation during the second year of life (Ruff & Rothbart, 1996; 2001). In particular, there is a noticeable developmental transition at approximately 18 months that has qualitative aspects that support the development of executive attention. Specifically, the development of symbolic

representation and self-referential ability are an important accomplishment at this age. These new abilities allow for greater inhibitory control through linguistic and symbolic means, as well as the ability to plan and pursue goal-directed action. Similar to the transition at nine to 12 months, maturation of the prefrontal cortex is responsible for the 18-month transition (Ruff & Rothbart, 1996; 2001).

By 24 months, the elementary executive attention seen in the later part of the first year has developed into a functional regulatory mechanism that allows greater levels of inhibition, self-control, and attention regulation in general (Ruff & Rothbart, 1996; 2001). The emergence of the executive attention system means that the lower level processes associated with the orienting/investigative system are, in some way, being facilitated or inhibited. These changes are associated with the continued maturation of the prefrontal cortex. Further maturation of the prefrontal cortex allows executive attention to continue to develop with further refinement and increasing control of attention during the preschool years. Children now demonstrate the ability to plan ahead and are subjected to both internal motivation and external demands for their attention (Ruff & Rothbart, 1996; 2001).

According to Colombo (2001) and Colombo and Cheatham (2006), executive attention is based in the integration of memory systems with the neural pathways that support alertness, orienting, and object recognition. The link between attention and memory is demonstrated by Oakes, Kannass, and Shaddy (2002) and Oakes and Tellinghuisen (1994). They both noted that the latency to turn toward an extraneous stimulus is dependent on familiarity with the object being examined. This illustrates that memory for an object impacts whether or not attention will be maintained on an object.

Summary

Attention develops gradually over the first years of life. Initially attention is largely determined by exogenous factors such as salient stimuli, but near the end of the first year evidence of executive attention is first seen as internal factors begin to govern attention. Executive attention continues to improve throughout the preschool years. The ability to increasingly control attentional resources and pursue goal-directed behavior coincides with improved ability to resist distraction. Control over attentional resources allows children to flexibly concentrate on stimuli central to the ongoing task, while at the same time, ignore extraneous stimuli. Together, Ruff and Rothbart (1996; 2001) and Colombo (2001) provide a framework that describes how attention begins to develop from birth into the preschool years.

Distractibility

The ability to control attentional processes is essential to resisting distraction. Distractibility refers to the process whereby a child is unable to resist orienting to stimuli in the environment that are competing for his or her attention and unable to maintain attentional focus on the target task. The development of inhibitory control is essential to resisting distraction. Individual differences that provide varying levels of inhibitory control determine whether an individual will be able to resist distraction or be distracted. Thus, it is executive control of attentional resources that determines distractibility.

There is a general trend for distractibility to decrease with age. Take, for example, Ruff and Capozzoli's (2003) study of 10-, 26-, and 42-month-olds engaged in toy play. The 10-month-olds were twice as distractible as the 26- and 42-month-olds (Ruff & Capozzoli, 2003), consistent with the view that executive attention exists in basic

forms in the later portion of the first year of life and continues to develop over the preschool years.

The Study of Distractibility

The typical paradigm used to study distractibility involves presenting the child with a task to complete, such as examining objects or completing a sequence of actions, with a distracting stimulus that is external to the task presented at random intervals (Kannass, Oakes, & Shaddy, 2006). Sometimes, the distractor may also be continuous such as when the television on in the background while the child is completing a task. Considering distractibility reflects the ability to resist orienting to the distractor and to maintain attention to the target task, looks to and from the task are the main index of distractibility. If a child is not distracted from the task, he or she will continue to look at the task and not look away from the task. Thus, when a continuous distractor is present, any off-task looks toward the distractor are considered evidence of distractibility. For intermittent distractors, the latency to turn toward the distractor is also considered a measure of distractibility. Furthermore, task performance may also serve as an index of distractibility. If a child is able to perform a task at a specific level when no distractions are present and this performance changes when a distractor is introduced, then it can be said that the distractors affected performance.

The study by Dixon and Salley (2007) in which twenty-two-month-olds were given the task of learning novel words exemplifies a typical distractibility study. For some of the children distractors were present in the form of either a person reading a children's book out loud or the presence of a dancing toy. Children who had experienced the distractors were not able to generalize the novel words to situations beyond the initial

learning phase. Children in the no distraction condition, on the other hand, were readily able to generalize the new words to new situations. Thus, the presence of a distractor significantly impaired the ability of 22-month-olds to generalize novel words.

Distractibility and the Development of Attention

Distractibility is largely dependent on the ability to inhibit responding to the distractor in favor of maintaining attention to the task at hand. Inhibition is an attentional process that is present in rudimentary forms at the end of the first year of life and improves significantly as executive attention develops over the preschool years (Ruff & Rothbart, 1996; 2001). This means that the development of executive attention is important to distractibility. As mentioned earlier, executive attention is attention that is governed primarily by internal motivation rather than external stimulation (Colombo, 2001), with goal-directed behaviors and planning as important aspects of executive attention (Ruff & Rothbart, 1996; 2001). The development of executive attention implies that there is self-regulation of attention, which in turn allows for the inhibition of response to a distractor. For toddlers and preschoolers, the motivation to engage in intrinsically interesting tasks is a contributing factor to their ability to resist distraction (Ruff & Rothbart, 1996; 2001).

In their discussion of distractibility, Ruff and Rothbart (1996; 2001) concluded that from approximately three months of age onward, children have the ability to resist distraction under the right circumstances. It is at three months of age that infants begin remaining alert for extended periods, which gives the orienting/investigative system more opportunity to operate. At this point, infants begin showing visual preferences that guides them to look at certain objects and patterns and not at others. From approximately six

months, Ruff and Rothbart believe inhibitory mechanisms become involved in distractibility. The rudimentary inhibitory mechanisms present at this age include peripheral narrowing and habituation. Regardless of age, Ruff and Rothbart view distractibility as an interaction of motivation, make-up of the distractor, and characteristics of the task. According to Colombo and Cheatham's (2006) framework for the development of executive attention, the neurological basis of executive attention lies in the connections between the frontal lobes and the dorsal pathway. This neurological basis provides insight into the mechanisms behind distractibility. The dorsal pathway is believed to support information concerning the locations of stimuli in the visual field (Colombo & Cheatham, 2006). Considering that being distracted typically involves looking away from the target task and toward the location of the distractor, the dorsal pathway is likely to be an important component of distractibility. This pathway, combined with the regions of the prefrontal cortex that support executive attention functions such as inhibition, provides the neural mechanisms that underlie of distractibility.

Factors Influencing Distractibility

Research has demonstrated that whether a child is distracted from an ongoing task by extraneous stimulation is influenced by several factors, including level of attentional engagement, duration of an ongoing look, characteristics of the distractor, and characteristics of the task. These factors will singly and collectively affect whether or not a child maintains attention to the target task when faced with competing stimuli. The salience of these factors also influence the distraction latency, which refers to the time

that lapses between distractor onset and the beginning of the child's head turn away from the target task toward the distractor (Tellinhuisen, Oakes, & Tjebkes, 1999).

The level of attentional engagement to a given task is an important factor that influences distractibility. Children engaged in focused attention to a task or stimulus react differently to a distractor than those engaged in casual attention. When engaged in focused attention, children make fewer head turns toward the distractor (Ruff & Capozzoli, 2003) and when they do look at the distractor, the latency to turn is much longer (Oakes, Tellinghuisen, & Tjebkes, 2000; Ruff & Capozzoli, 2003; Tellinghuisen & Oakes, 1997) than when not engaged in focused attention. In addition, as the duration of looking at the task increases, the latency to turn toward the distractor increases (Anderson, Choi, & Lorch, 1987; Richards & Turner, 2001). Also, the probability of turning toward the distractor decreases as the duration of looking at the task increases (Richards & Turner, 2001). The critical duration of a single look at the task seems to be 15 seconds (Anderson et al., 1987). Once a look continues beyond 15 seconds, the probability the child will look toward the distractor is greatly reduced (Anderson et al., 1987).

Characteristics of the distractor itself also influence distractibility. Ruff and Capozzoli (2003) found that, depending on age, certain types of distractors are more effective at gaining attention. The 10-month-olds in their study were most distracted by an audio-visual distractor. The audio-visual distractor and the video-only distractor proved to be highly effective in distracting the 26-month-olds, while the 42-month-olds were most distracted by the visual-only distractor. Thus, depending on the age of the child, certain characteristics promote distractibility more than others. Similarly, Oakes et

al. (2000) and Tellinghuisen and Oakes (1997) observed infants to be more distracted by a checkerboard visual display than a solid rectangle display.

A final factor that has been implicated in influencing distractibility is the characteristics of the task from which the child is being distracted. According to Oakes et al. (2000), children turned toward distractors less when playing with a multi-component toy versus a toy made up of a single part. Additionally, Doolittle and Ruff (1998) noted that eight-month-old infants had slower distraction latencies when examining novel toys compared to familiar toys. Oakes et al. (2002) and Oakes and Tellinghuisen (1994) have also noted familiarity with the target stimulus to be an important influence on distractibility.

Summary

Distractibility reflects an inability to control attentional processes and maintain focus on the target task. It is the development of specific neural mechanisms responsible for executive attention that provides young children with the attentional mechanisms necessary to resist distraction, and these mechanisms improve as children get older. However, an interaction between multiple factors that determines whether a distractor will be effective in gaining a child's attention. These factors range from endogenous factors, such as attentional control, to exogenous factors, such as distractor and task characteristics. These factors combine with the developmental stage of the child to determine distractibility.

The Present Study

Given the evidence that both foreground and background television are a pervasive part of the lives of most children today, the potentially distracting effects of

television on three-year-olds' attention as they engaged in learning activities were investigated in the present study. Although there is evidence that television distracts young children during toy play (Courage et al., 2010, Schmidt et al., 2008), little is known about the impact of these distractions on young children's ability to learn during play activities.

In the present study three questions were investigated. The first was whether background television would distract three-year-old children during an adult-child interaction. The second question was whether background television would impair three-year-olds' performance on certain cognitive tasks that were taught during the interaction. The third and final question examined in the present study was whether the maturity of children's executive attention processes is related to distractibility and task performance in the presence of background television. The better a child's executive functioning skills, the better he or she is expected to perform on the tasks.

There are several possible outcomes for the first two questions. It may be that the presence of background television would distract the children and interfere with their ability to perform the tasks. In that case, the three-year-olds might make more errors and/or take longer to complete the tasks compared to children who were instructed without the presence of background television. Alternatively, three-year-olds may be able to resist the distraction provided by the television or "multitask" such that they can succeed on the tasks as well as periodically attend to the television. This suggests that they are able to successfully deploy attentional resources between ongoing activities and television viewing. They are attending to both and neither suffers at the expense of the other. This might be expected as the constant presence of television in the lives of young

children may have enabled them to ignore or to habituate to the background stimulation provided by television. If this were the case, it would be expected that children in the television on and television off conditions would demonstrate similar levels of performance with or without the presence of background television.

In the present study, three-year-old children were engaged in two learning tasks with an adult. In the first task, the child listened to the researcher read a book depicting a child constructing a toy from pieces that had to be assembled in a particular serial order. The child was expected to recall certain details of the story and also to be able to reconstruct a real model of the toy depicted in the story. The second task involved the participants putting together a puzzle such that it was identical in all aspects to a model puzzle. To successfully complete the Puzzle Task, the child had to learn to visually refer to the model puzzle as it was being completed. The Puzzle Task was originally derived from Wertsch, McNamee, McLane, and Budwig (1980) and is commonly used as a measure of executive functioning and attention regulation in preschool children (Davis, Burns, Synder, Dossett, & Wilkerson, 2004; Harris, Robinson, Chang, & Burns, 2007). For half of the children a television playing a child-directed program was on in the background during the interaction and for the other half of the children the television was turned off.

Method

Participants

Fifty-six three-year-olds ($M = 3.32$ years, $SD = 0.10$) completed the study. Within the sample there were 23 boys and 33 girls. Seven additional participants were not included in the final sample due to not completing the tasks ($n = 3$), parental interference

(n = 1), and procedural errors (n = 3). All participants were recruited from an existing database of parents who gave birth at the Janeway Children's Hospital, St. John's, Newfoundland, and who had expressed interest in participating in research. A brochure (see Appendix A) describing the study was sent out by mail to make subsequent contact with the mothers and a maximum of three phone calls were made in attempt to arrange an appointment. Six hundred and fifty brochures were sent out, but the majority of these mothers were unable to be reached by phone. It is estimated that about 50% of the mothers who were reached agreed to participate (with just over half of them actually participating), with the other 50% declining. The parents of preschoolers who participated (45 mothers; 11 fathers) were Caucasian and predominately of middle socioeconomic status.

Tasks

Book Task. The Book Task was derived from a task developed by Simcock and Dooley (2007). For the purposes of the current study, a book was created to exclude the possibility that the participants had previous exposure to a commercially available book. The book was entitled *Oscar Falls Down*. To make the book equally interesting to both sexes, two versions of the book were created: one with a little girl as the main character and another with a little boy as the main character. Both versions consisted of colored photographs and a brief story depicting either the girl or boy performing a sequence of actions to restore Oscar the Grouch, who had fallen from his trash can and broken into pieces. The photos in the storybook were of a "Kid K'nex Sesame Street Oscar" building set being assembled in five steps. This building set has 14 pieces and is appropriate for

children age two to five years. See Figure 1 for a picture of the Oscar toy. The story also included an explanation for the order in which Oscar was to be assembled by the child.

Puzzle Task. The Puzzle Task, adapted from Wertsch et al. (1980), required the child to complete two puzzles – a practice puzzle and a test puzzle. Both the practice puzzle (a train) and the test puzzle (a truck) were commercially available from Lauri toys and were made of colored crepe rubber. The train puzzle had 13 pieces and can be seen in Figure 2. All of the pieces, except the three small wheels, were glued in place to act as a simple practice puzzle. The purpose of the practice puzzle was to ensure that the child understood the instruction to make his or her puzzle "look the same" as the model puzzle. The truck puzzle had 15 pieces, all of which were removed during the truck puzzle learning phase. For the truck puzzle test phase, only the six cargo pieces were removed. The truck puzzle is shown in Figure 3. In order to successfully complete the Puzzle Task, the child had to learn to make his or her puzzle look identical to the model puzzle in front of the researcher by referring to the model.

Questionnaires

Behavior Rating Inventory of Executive Function – Preschool Version. The Behavior Rating Inventory of Executive Function – Preschool Version (BREIF-P; Gioia, Espy, & Isquith, 2003) (see Appendix B) is a questionnaire designed to assess executive functioning in two- to five-year-old children and was completed by one of the participants' the parents. The 63-items comprising the BRIEF-P represent five domains of executive functioning: Inhibition (16 items), Shifting (10 items), Emotional Control (10 items), Working Memory (17 items), and Planning/Organization (10 items). These

Figure 1. A picture of the Kid K'nex *Sesame Street* Oscar building set used in the Book Task assembled, as it would be in the sequence reconstruction.

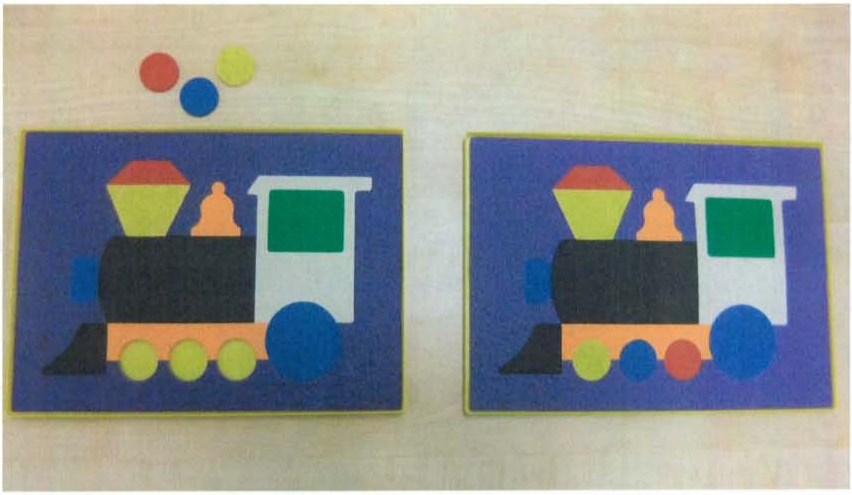

Figure 2. A picture of the train puzzle used in the initial practice phase of the Puzzle Task. The puzzle on the right is the model and the one on the left is the child's puzzle.

Figure 3. The truck puzzle used in the Puzzle Task. The puzzle on the left is the child's puzzle and the one on the right is the model puzzle.

executive functioning skills are important perquisites to successful completion of the two tasks employed in this study.

Each of the five executive functioning scales yields a raw score that can be transformed into a *t* score and a percentile rank. A total score is derived through combining the scores for all 63-items. The total score can also be transformed into a *t* score and a percentile. In addition to the five domain raw scores and the total score, combining two of the five domains forms three other indices of executive function: the Inhibitory Self-Control Index (ISCI) is a combination of the Inhibition and Emotional Control scales and represents the ability to control behavior; the Flexibility Index (FI) is formed through the addition of the Shift and Emotional Control items and is an index of flexibility to change between a series of actions; the final composite index is the Emergent Metacognition Index (EMI), which is a product of the Working Memory and Plan/Organize scales and represents a child's ability to effectively pursue future-oriented problem solving.

Each of the five scales of the BRIEF-P demonstrates good internal consistency, with the Cronbach's alpha value's ranging from .80 (Plan/Organize) to .90 (Inhibit). The total score has a Cronbach's alpha of .95. The BRIEF-P also shows good temporal stability over a period of approximately 4.5 weeks. Correlations between two administrations range from .78 (Plan/Organize) to .90 (Inhibit), with the total score having $r = .90$ (Isquith, Gioia, & Espy, 2004).

MacArthur-Bates Communicative Development Inventory: Level III. Language development was assessed using the MacArthur-Bates Communicative Development Inventory: Level III (CDI III; Dale, 2001) (see Appendix B). The CDI III

is a brief two-page questionnaire designed to assess vocabulary, grammatical complexity, semantics, syntax, and comprehension in 30- to 37-month-olds and is considered to be a general measure of cognitive ability in this age group. It is based on the standardized MacArthur-Bates Communication Development Inventories *Words and Gestures* and *Words and Sentences* that have been used extensively with infants and toddlers from 8 to 30 months of age.

Television Viewing and Demographic Information Questionnaire. The Television Viewing and Demographic Information Questionnaire (see Appendix B) is an 11-item questionnaire designed specifically for the current study. This questionnaire gathers demographic information about the family and assesses the television viewing habits of the child and his or her family.

Procedure

The study took place in a research room at Memorial University. The room was set up to approximate a typical family room, with a child-size table and chairs in the center of the room (see Figure 4). The child sat on a chair centered at the table, facing the front of the room. Another child-size chair was positioned to the right of the table for the researcher. The parent was seated on a chair in the rear left corner of the room. A 21-inch television was located on a 76 cm high table in the front right corner of the room. The child's table was approximately 73 cm from the television table. One Sanyo digital color CCD video camera was positioned on the center of the television table to record the actions of the child. A USB Snowflake Blue Microphone captured vocalizations.

Participants were randomly assigned to either the TV-On condition or the TV-Off condition, with an approximately equal number of boys and girls in each condition. *The*

Figure 4. The research room where the study was conducted.

Backyardigans: Tale of the Mighty Knights DVD was playing during the TV-On condition, whereas the television was off (i.e., displaying a blank black screen) in the TV-Off condition. Additionally, the order of the tasks was counterbalanced such that half of the participants in TV-On and TV-Off condition received the Book Task first and the Puzzle Task second, and the other half completed the tasks in reverse order. As well, the order of the verbal recall and the sequence recall within the Book Task was counterbalanced to prevent order effects.

Upon entering the research room, the researcher described the study in detail to the parent and informed consent was obtained. While the parent completed the consent form (see Appendix C), the child was directed to a *Pop-Up Pets* toy placed on the child-size table. The researcher sat down at the table with the child and attempted to engage him or her in conversation. This was done to reduce the shyness of the child and to make him or her more comfortable in the setting. Once consent was obtained, the toy was taken away and the experiment began. The parent completed the three questionnaires while the child completed the tasks.

The Book Task began with the researcher reading the book to each child. To familiarize the child with the material to be asked during the test portion of the task and to ensure the child was paying attention to the story, the researcher asked questions about details in the story during the reading. An example of a question asked during the reading would be "What color is the boy's/girl's shirt?" If the child gave an incorrect answer or did not know the answer, the researcher would provide the correct answer.

The test portion of the Book Task consisted of two phases: verbal recall and sequence reconstruction. The verbal recall phase involved asking the child six questions

from the story in random order. All verbal recall questions were open-ended, with one or two word answers. If a child seemed shy or did not answer the questions for the researcher, the questions were framed such that it seemed like the child was telling the parent about the story and the parent would try to get the child to answer. The portion of verbal recall questions answered correctly was scored. If parents interfered with the child's answering, that particular question was not included in the score for that child. Parental interference included the parents providing the child with any portion of the answer (even if it was only the first syllable of the answer) and phrasing the question in a way that gave the child more clues than the original question.

For the sequence reconstruction, the child had to recreate the sequence depicted in the book to put Oscar back together. Participants were presented with the actual Oscar toy that was shown in the pictures in the book and were told "Oscar's all broken into pieces." They were then asked to put Oscar back together exactly like the boy or girl did in the book. The child then had to attach Oscar's legs, head, and arms to his body, attach Slimey Worm to Oscar's hand, and place Oscar and Slimey into Oscar's trash can to complete the sequence exactly as it was depicted in the book. To get the child started, the researcher would pick up Oscar's body and ask what the boy or girl in the book did first. The number of target actions and pairs of target actions produced were scored. The number of target actions produced is simply a measure of whether the child performed the actions portrayed in the story. An example of a target action would be the child attaching Oscar's head to his body. There were five target actions performed in the story. The actions that proceeded or followed a given action were irrelevant for the target actions measure of sequence performance. Errors did not matter in this measure of sequence

performance. As long as the child performed the target action, it was considered correct. Any actions performed outside the five target actions were ignored. Unlike the target actions measure, the number of pairs of target actions was order sensitive. This measure reflects whether the child retained the specific order of actions described in the story. Every action and the action that immediately followed it, made up a target pair. Here, the child had to put Oscar's legs on immediately before his head and his arms immediately after his head and so on, to give a total of four pairs of target actions. In the example, the legs followed by the head is one pair of target actions and the head followed by the arms is another pair of target actions. Given the sensitivity to order, errors were counted in the pairs of target actions measure. It should be noted that in order for an action to be counted as a target action, the part had to be attached and, in the case of the placement in the garbage can, Oscar had to be fully in the garbage can. Any pieces the child picked up, but did not attach were not considered errors.

To begin the Puzzle Task, the child completed a practice train puzzle to ensure he or she understood to look to the model puzzle in order to make their puzzle look identical to the model. There were two copies of the train puzzle: one placed in front of the child and one placed in front of the researcher. The three small wheels were taken out of the child's puzzle by the researcher and placed to the left of the child. The child was told that the two puzzles are exactly alike and that he or she has to put the puzzle in front of him or her together so it looks exactly like the puzzle in front of the researcher. Thus, the puzzle in front of the researcher is considered the model puzzle. As the three pieces were the same circular shape but different colors, the child had to refer to the completed puzzle in front of the researcher to be successful. It was stressed to the child that the two puzzles

had to look identical. The researcher provided help through pointing and explanation. For example, if a child asked the researcher where the red piece went, the researcher would ask the child to point to the red piece on the model puzzle and then direct the child to put his or her red piece in the same place as it was on the model. The researcher taught the child to look at the model puzzle to determine where to place each piece. For some children, the practice train puzzle was completed several times, until correct. Upon successful completion of the train puzzle, the train puzzle was removed and the truck puzzle was placed in front of the child. An identical puzzle was placed in front of the researcher. This was the truck puzzle learning phase. The child and the researcher then proceeded to remove all of the pieces in the child's truck puzzle. The child was instructed to complete the truck puzzle as he or she did with the train puzzle. Again, making the two puzzles look identical was stressed and the researcher provided the child with help as required.

Following the completion of the truck puzzle, the researcher removed the six square pieces on the child's puzzle that made up the truck's cargo. This time the child was asked to complete the puzzle by him- or herself, with reference to the model to assess whether the child learned how to look at the model puzzle to correctly put the puzzle together during the adult-child interaction. The researcher provided no assistance. The number of pieces inserted in the correct position was recorded.

Coding

For each participant, the time it required for him or her to complete each task was recorded. For the Book Task, timing started as soon as the researcher began to read the first word of the book's title. Timing ended either when the child answered the last

verbal recall question or completed the last action in the sequence, depending on the order he or she received the Book Task tests. Any time required to remove and retrieve task-related materials was ignored. This gave a total time to complete the Book Task, a time to complete the verbal recall, and a time to finish the sequence. Timing for the Puzzle Task began as soon as the train practice puzzle was placed on the table and continued until the child placed the last piece in the truck puzzle during the test. Again, any time required to take away and retrieve task-relevant materials was not included. This produced a total time to complete the puzzle task as a whole and a time to complete the Puzzle Task test.

In addition, the frequency and duration of the child's looks were coded as an index of visual attention. A look was defined as any noticeable eye or head movement. Categories of coding included looks to the task, the researcher, the television, and other. Looks to the task (i.e., on-task looks) included any looks to task-relevant materials. In the Book Task this was to the book or the Oscar toy. In the Puzzle Task, on-task looks included looks to either the train puzzle or the truck puzzle. Looks to the researcher or television (off-task looks) were when the child looked to either the researcher or the television, respectively. The "other" category (also off-task looks) comprised looks to anything that was not included in one of the above categories. In most case, this category represented looks to the parent or looks around the research room.

As looks to the model puzzle during the practice and the test are indicative of understanding how to successfully complete the Puzzle Task, the number of looks to the model puzzle during the truck puzzle learning phase and the puzzle test were also noted. Here, any look the child made to the model puzzle during these portions of the puzzle

task was counted. Additionally, during the puzzle task test, looks to the model that immediately preceded the placement of a puzzle piece were counted.

Results

Television Viewing Questionnaire Data

The parental report of television viewing habits at home revealed that the three-year-olds watched, on average, 1.74 hours per day (range was .42 hours to 4.00 hours) of television. This is consistent with the data from several large-scale representative surveys that indicates that preschoolers watch approximately two hours of television daily (e.g., Rideout & Hamel, 2006; Vandewater et al., 2005). Very few parents were actually present during this television viewing. Only 25.9% of parents indicated that they are present all the time or most of the time that their children watch television. Most parents seem to occasionally view with their children, with 44.4% co-viewing about half of the time and 29.6% viewing with their children less than half of the time. However, exposure to television is not limited to time spent viewing as a primary activity, as 46.3% of the parents indicated that the television is on most of the time or always in their homes, regardless if anyone was actually watching the television. A further 33.3% indicated that the television is on in their homes sometimes, with 20.4% reporting that the television is on rarely or never. These data confirm that television is a common and near constant presence in the homes of the three-year-olds in this study. Television, however, is not common in the bedrooms of the preschoolers in the sample as only 13.2% of the three-year-olds were reported to have a television in their bedroom.

The television viewing questionnaire also assessed parental opinions of television. However, it is important to note that the parental sample was well educated as 55.6%

have a university degree and 33.3% completed a skill trade program. Consistent with previous reports (e.g., Rideout, 2007; Rideout & Hamel, 2006) the majority of the parents (79.6%) believed television was effective for teaching and entertaining their preschoolers. Yet, 57.4% of these same parents believed that television has the potential to interfere with toy play and take time away from social interactions, while 27.8% of parents believed that television does not affect either play or social interactions. Additionally, 7.4% indicated that television only interferes with toy play and another 7.4% indicated that television takes time away from social interactions.

Frequency and Duration of Looks during the Book Task and the Puzzle Task

The first goal of this study was to examine whether the presence of background television distracted the children during the learning and performance of the tasks. In order to test this, the frequency of their looks away from the tasks and the total duration of those looks were determined. A series of 2 (Looks Where: on-task, off-task) x 2 (Condition: TV-On, TV-Off) x 2 (Sex: boys, girls) mixed analyses of variance (ANOVAs) with children's looks-on-task and looks-off-task as the within-subject factor and with condition (TV-On versus TV-Off) and gender as the between-subject factors were conducted. The composite dependent measure *looks where* (on or off task) was selected for analyses rather than the more direct measure of distractibility *looks to the television* because the frequency and duration of those measures in the TV-off group was zero and not appropriate for an analysis of variance. These results are described below for the Book Task followed by those for the Puzzle Task. Whenever necessary, the p values for the follow-up t-tests were corrected (Bonferroni) for the number of comparisons made.

Book Task. As evident from the descriptive statistics in Table 1, children in the TV-On condition looked to and from the Book Task more frequently than did children in the TV-Off condition. This indicates that the children in the TV-On condition looked off-task more than children in the TV-Off condition. Off-task looks included looks to the television, researcher, and elsewhere. In the Book Task, the largest number of off-task looks was to the television. Similarly, Table 1 also shows that the children in the TV-On condition spent more time looking off-task than children in the TV-Off condition. The greatest duration of off-task looks for children in the TV-On condition was to the television.

The significance of those findings was confirmed using a mixed ANOVA that was conducted on the duration of time spent looking on- and off-task. The results of tests of within subjects effects revealed a significant main effect of where the children looked: $F(1, 51) = 145.26$, $p = .000$, partial $\eta^2 = .74$ indicating that the children spent a significantly longer duration of time looking on-task ($M = 341.15$ secs, $SD = 50.38$) than off-task ($M = 193.72$, $SD = 86.59$). This finding was qualified by a significant Looks Where x Condition interaction: $F(1, 51) = 12.20$, $p = .001$, partial $\eta^2 = .19$ that is shown in Figure 5. Follow-up independent samples t-tests indicated that children showed a longer duration of looking on-task when the television was off rather than on: $t(53) = 2.96$, $p = .005$ and a longer duration of looking off-task when the television was on rather than off: $t(53) = 2.14$, $p = .037$. This means that the three-year-olds in the present study spent significantly longer looking on-task, overall. However, when the television was on,

Table 1

Mean Frequency and Duration of Looks On- and Off-Task During the Book Task

TV Condition	Task	TV	Researcher	Other	On-Task	Off-Task
			Mean (SD) frequency			
TV-On	30.15 (12.41)	30.15 (17.33)	16.70 (13.18)	10.30 (4.91)	30.15 (12.41)	57.15 (23.50)
TV-Off	18.00 (8.63)	0.00 (0.00)	23.21 (13.11)	14.39 (7.11)	18.00 (8.63)	37.61 (18.29)
			Mean (SD) duration (in seconds)			
TV-On	322.03 (38.52)	129.34 (89.67)	37.57 (34.92)	51.46 (43.76)	322.03 (38.52)	218.38 (85.89)
TV-Off	359.59 (54.12)	0.00 (0.00)	57.43 (32.53)	112.51 (86.15)	359.59 (54.12)	169.94 (81.85)

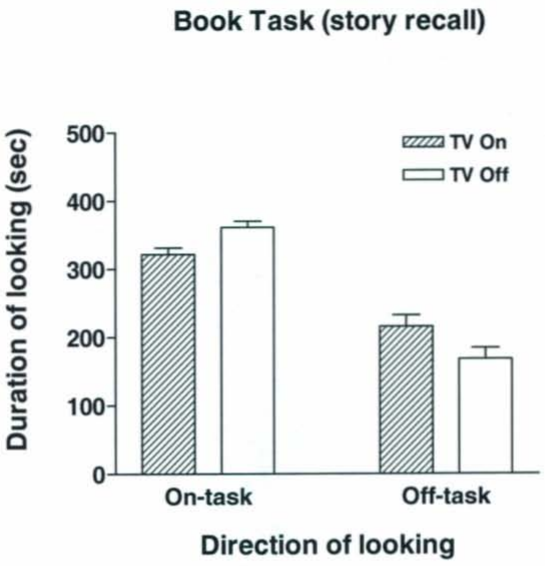

Figure 5. This figure shows the significant Condition x Looks Where interaction for duration of looking on-task and off-task during the Book Task.

there was significantly less time spent looking on-task. There were no significant main effects or interactions involving sex.

Another parallel mixed ANOVA was conducted on the frequency of looks on-task and off-task and revealed a significant main effect of where the children looked: $F(1, 51) = 109.15$, $p = .000$, partial $\eta^2 = .68$ indicating that the children looked off-task ($M = 47.20$ looks, $SD = 23.03$) more frequently than they did on-task ($M = 23.96$ looks, $SD = 12.20$). The Looks Where x Condition interaction approached significance: $F(1, 51) = 2.71$, $p = .106$, partial $\eta^2 = .50$ meaning there was a trend for children to look off-task more when the television was on compared to when it was off. There were no main effects or interactions involving sex.

Puzzle Task. As with the Book Task, children in the TV-On condition looked off-task more than children in the TV-Off condition during the Puzzle Task. Means and standard deviations are shown in Table 2. Again like the Book Task, the majority of off-task looks were to the television. A mixed ANOVA on the duration of time spent looking on- and off-task was conducted and the results of the tests of within-subject effects showed a significant main effect of where the children looked: $F(1, 51) = 550.85$, $p = .000$, partial $\eta^2 = .92$. This indicates that the children looked on-task ($M = 274.90$ secs, $SD = 69.19$) for a significantly greater duration than they did off-task ($M = 38.57$ secs, $SD = 61.79$). This main effect was qualified by several interactions that are illustrated in Figure 6. There was a significant Looks Where x Condition interaction: $F(1, 51) = 6.65$, $p = .013$ partial $\eta^2 = .12$. An independent samples t-test indicated that children in the TV-On condition spent a significantly greater amount of time looking off-task during the

Table 2

Mean Frequency and Duration of Looks On- and Off-Task During the Puzzle Task

TV Condition	Task	TV	Researcher	Other	On-Task	Off-Task
			Mean (SD) frequency			
TV-On	23.26 (13.57)	16.56 (15.59)	4.85 (7.23)	.74 (1.46)	23.26 (13.57)	22.15 (15.42)
TV-Off	6.36 (5.37)	0.00 (0.00)	3.36 (5.67)	.89 (2.85)	6.36 (5.37)	4.25 (8.15)
			Mean (SD) duration (in seconds)			
TV-On	285.53 (56.50)	55.16 (68.93)	5.36 (7.39)	6.92 (29.63)	285.53 (56.50)	67.44 (70.42)
TV-Off	264.65 (79.23)	0.00 (0.00)	4.20 (8.37)	6.54 (27.58)	264.65 (79.23)	10.74 (35.00)

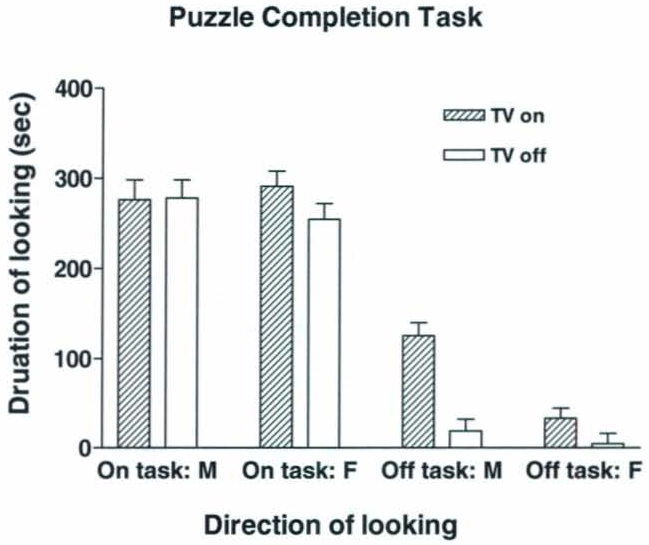

Figure 6. The significant Looks Where x Condition x Gender interaction shown above indicates that there was no difference in duration of on-task looks for either girls or boys as a function of TV being on or off. However, girls showed very low durations of looking off-task and this was mostly when the TV was on rather than off. Boys showed more off-task looking than girls and this was also true when the TV was on.

second task than children in the TV-Off condition: $t(53) = 3.80$, $p = .000$. In addition, there was a Looks Where x Sex interaction: $F(1, 51) = 6.27$, $p = .016$, partial $\eta^2 = .11$. A follow-up independent samples *t*-test revealed that the boys spent a significantly greater duration of time looking off-task compared to the girls: $t(53) = 3.03$, $p = .004$. However, the boys and girls did not statistically differ in the amount of time looking on-task: $t(53) = 2.02$, $p = .841$. These interactions were further qualified by a significant Looks Where x Condition x Sex interaction: $F(1, 51) = 8.90$, $p = .004$, partial $\eta^2 = .15$. Follow-up independent samples *t*-tests revealed that most of the girls' very low duration of looking off-task was when the television was on rather than when it was off: $t(31) = 3.75$, $p = .001$ and the boys also looked off-task significantly longer when the television was on than when it was off: $t(20) = 3.68$, $p = .001$.

With respect to the frequency of looks on-task and off-task, a repeated measures ANOVA revealed a significant main effect of Looks Where: $F(1, 51) = 11.22$, $p = .002$, partial $\eta^2 = .18$. As with the frequency data from the Book Task, the children had a higher frequency of looks off-task ($M = 13.04$ looks, $SD = 15.14$) than on-task ($M = 14.65$ looks, $SD = 13.26$) in the Puzzle Task. There were no other significant main effects or interactions.

Summary. The results of the frequency and duration of looking analyses indicated that the television did distract three-year-old children during both the Book and Puzzle Tasks. Children in the TV-On condition were more likely to look off task and to spend more time looking off task than three-year-olds in the TV-Off condition.

Time to Complete the Tasks

Book Task. Another measure of whether or not the presence of background television distracted the children during the Book Task and the Puzzle Task was the duration of time it took them to complete those tasks. The means and standard deviations of the duration of time required to complete the Book Task and each of the Book Task tests (story recall; sequence recall) is displayed in Table 3. The results of an independent samples *t*-test indicated that the total time required to complete the entire Book Task did not differ in the TV-On and TV-Off conditions, $t(54) = .22$, $p = .827$. Time to complete the two recall test phases of the Book Task also did not differ in the TV-On and TV-Off conditions. For the verbal recall, the children took about the same amount of time in the TV-On condition and the TV-Off condition, $t(54) = -.77$, $p = .447$. Similarly, the TV-On and the TV-Off conditions required approximately the same amount of time to complete the sequence, $t(54) = 1.40$, $p = .166$. Thus, the presence of the television did not affect the time required for three-year-olds to finish the Book Task and its two recall tests.

Puzzle Task. The means and standard deviations of the time needed to complete the Puzzle Task as a whole and the time to complete the test phase are also included in Table 3. The presence of background television did affect to total time to complete the Puzzle Task. It took the three-year-olds in the TV-On condition significantly more time to complete the task than the children in the TV-Off condition, $t(54) = 3.09$, $p = .003$. The children in the TV-On condition also took significantly longer to finish the puzzle task test than the children in the TV-Off condition, $t(54) = 2.70$, $p = .009$. The greater

Table 3

Time to Complete All Phases of the Study in Seconds

Phase of study	TV-On		TV-Off	
	M	*SD*	*M*	*SD*
		Book Task		
Book Task total	539.68	104.56	533.67	100.18
Verbal recall	156.41	64.97	171.03	77.18
Sequence	158.48	53.72	140.77	39.69
		Puzzle Task		
Puzzle Task total	349.75	98.20	272.69	88.22
Test	107.27	56.27	74.33	31.84

time required for the three year-olds in the TV-On condition to complete the entire puzzle task and the puzzle task test demonstrates that the television did distract them during this task.

Summary. Television did not have the same effect on the Book and Puzzle Tasks in terms of the time taken to complete each task. For the Book Task, the children in the TV-On and TV-Off groups took equally long to complete the task and the tests. However, the presence of television did distract them during the Puzzle Task as the three-year-olds in the TV-On condition took significantly longer compared to those in the TV-Off condition. Thus, the television affected the time needed to complete the Puzzle Task, but not the Book Task.

Performance on the Tasks

The second goal of this study was to examine children's performance on two cognitive tasks with and without the presence of background television. To do this a series of ANOVAs was conducted on children's verbal recall of story details and their recall of the sequence in which the Oscar toy was reconstructed in the Book Task. Children's performance on the Puzzle Task was assessed with ANOVAs and Chi Square testing.

Book Task: Verbal recall. In order to assess whether background television affected children's performance on the test portions of the Book Task, univariate analyses of variance (ANOVAs) were conducted on the verbal and serial recall of task performance. A 2 (Sex) x 2 (Condition: TV-On, TV-Off) ANOVA of the proportion of verbal recall questions answered correctly revealed a significant main effect of condition, $F(1, 52) = 4.15$, $p = .047$. This indicated that three-year-olds in the TV-On condition (M

= .42, *SD* = .26) correctly recalled a significantly smaller proportion of story details than those in the TV-Off condition (*M* = .55, *SD* = .19). There was no significant main effect or interaction involving sex. This finding indicated that the presence of background television appeared to interfere with three-year-olds ability to recall verbal information from the story.

The number of verbal recall questions answered correctly was significantly correlated with the Using Language scale on the MacArthur CDI III, $r = .28$, $p = .049$. Children who had higher scores on language conventions (e.g., saying that a horse is an animal) answered a higher portion of the verbal recall questions correctly.

Book Task: Recall of action sequences. The Book Task sequence was scored in two ways: the number of target actions produced regardless of order and the number of pairs of target actions produced according to the order specified in the book. In the book, the main character attached Oscar's legs first and then followed by attaching his head and then his arms. Once the arms were attached, Slimey was fastened to Oscar's hand and, finally, Oscar and Slimey were placed in Oscar's trash can. For the number of pairs of target actions measure, the child had to perform the sequence in the exact order described above. The child could perform the described actions in any order for the target actions measure. The results of a 2 (Sex) x 2 (Condition: TV On, TV Off) ANOVA on the number of target actions produced no main effects or interactions. Both the males (*M* = 4.61 actions, *SD* = .78) and the females (*M* = 4.58 actions, *SD* = .71) performed equally well on the measure of number of target actions produced regardless if the television was on (*M* = 4.50 actions, *SD* = .79) or off (*M* = 4.68 actions, *SD* = .67). Similarly, a 2 (Sex) x 2 (Condition: TV-On, TV-Off) ANOVA of the number of target pairs produced was not

significant. Overall, performance on the pairs of target actions measure was low with the males (M = 1.61 pairs, SD = 1.44) and the females (M = 1.67 pairs, SD = 1.34) performing at the same level regardless of whether the television was on (M = 1.64 pairs, SD = 1.45) or off (M = 1.64 pairs, SD = 1.31).

Puzzle Task performance. There was a ceiling effect in performance on the Puzzle Task test. Twenty-eight three-year-olds correctly placed all six pieces, making it inappropriate to analyze these data with an ANOVA. Thus, the participants were grouped on an all or none basis: those who inserted all six puzzle pieces correctly versus those who inserted less than six pieces correctly. This resulted in two equal groups of 28. A Chi Square analysis revealed that the distribution of the children who completed the puzzle correctly and those who completed it incorrectly did not differ in the TV-On and TV-Off groups, $\chi^2 = .00$, $p > .05$. This indicates that the presence of background television did not affect children's performance on the puzzle completion in the Puzzle Task.

A critical component of successful Puzzle Task performance was the children's ability to monitor their own performance by checking their puzzle with that of the model. To assess whether the children understood the need to look at the model puzzle to successfully complete the puzzle test, a 2 (Condition: TV-On, TV-Off) x 2 (Puzzle Score: Correct, Incorrect) ANOVA on the frequency of looks to the model puzzle during the puzzle test was conducted. The analysis revealed only significant main effects of Condition: $F(1, 51) = 7.45$, $p < .01$ and of Puzzle Score: $F(1, 51) = 8.64$, $p < .006$. No interactions were found. The Condition main effect indicated that children in the TV-On

condition ($M = 8.07$, $SD = 5.14$) looked to the model more times than did the children in the TV-Off condition ($M = 5.29$, $SD = 3.20$), $t(53) = 2.43$, $p = .019$. This likely reflects the fact that background television interrupted ongoing looks to the model with the children looking back to the model after looking up to the television. The children in the TV-Off condition did not have the television to interrupt looks to the model and, thus, needed to look back and forth to the model less. The main effect of Puzzle Score indicated that children who completed the puzzle correctly ($M = 8.14$, $SD = 5.15$) looked to the model more frequently than did the children who did not complete the puzzle correctly ($M = 5.11$, $SD = 2.95$), $t(53) = 2.66$, $p = .010$. This is consistent with the assumption that children who did the puzzle correctly better understood the need to look to the model puzzle.

Summary. The presence of background television was not found to have an effect on three out of four measures of performance used in the study. The two measures of sequence recall in the Book Task and the measure of puzzle performance in the Puzzle Task did not differ across the TV-On and the TV-Off conditions. The only measure of performance that was affected by the presence of background television was the proportion of the verbal recall of the book's details in the Book Task: three-year-olds in the TV-On condition recalled a significantly lower portion of the verbal recall questions correctly compared to those in the TV-Off condition. Thus, it appears that the presence of background television affects some measures of performance but not others. However, it was noted that level of language development had some predictive power in terms of verbal recall scores and that more looks to the model puzzle in the Puzzle Task lead to better success on the puzzle test.

Task Performance and Executive Functioning

The third goal of the study was to assess whether individual differences in the maturity of the children's executive attention process were related to their performance on the Book and Puzzle Tasks. For the Book Task, correctly answering the verbal recall questions was not related to any of the BRIEF-P scales or indices, all $p > .05$. In contrast, the number of pairs of target actions produced in order was significantly related to two sub-scales of the BRIEF-P. The number of pairs of target actions produced was related to the Shift sub-scale of the BRIEF-P, $r = -.30$, $p = .049$. The Emergent Metacognition sub-scale was also significantly related to the number of target pairs correctly produced, $r = -.30$, $p = .047$. The more pairs of target actions produced, the lower the score on the BRIEF-P Shift and Emergent Metacognition sub-scales. A lower score on the BRIEF-P indicates a higher level of executive functioning. For the Puzzle Task, children who did the puzzle correctly differed from those who did not on several sub-scales of the BRIEF-P. The mean raw BRIEF-P scores of children who completed the puzzle correct and those who did not complete it correctly are compared in Table 4. Independent samples *t*-tests revealed that children who completed the puzzle correctly received significantly lower scores (i.e., higher functioning) on the Working Memory, the Plan/Organize, and the Emergent Metacognition sub-scales (all $p < .05$). This indicates that three-year-olds who completed the puzzle test correctly possess better executive functioning skills in the domains of working memory, planning/organization, and emergent metacognition than children who failed to complete the puzzle correctly. However, as only three of the values were significant, replication is necessary to confirm the results.

Table 4

Comparison of BRIEF-P Raw Scores of Children who Completed the Puzzle Task Correctly or Incorrectly

BRIEF-P scales and indices	Correct		Incorrect			
	M	*SD*	*M*	*SD*	*t*(41)	*p*
Inhibit	23.70	4.58	24.21	5.18	-.342	.734
Shift	13.13	3.65	14.05	3.35	-.857	.397
Emotional Control	15.43	3.07	15.55	3.43	-.116	.908
Working Memory	22.09	4.46	24.95	4.82	-2.02	.050
Plan/Organize	13.78	2.32	15.40	2.44	-2.23	.031
Inhibitory Self-Control	39.13	6.03	39.55	7.84	-.198	.844
Flexibility	29.43	6.03	29.60	6.14	-.089	.930
Emergent Metacognition	35.87	5.77	40.35	6.80	-2.34	.024
Global Executive Composite	88.13	13.06	93.85	15.35	-1.32	.194

Discussion

This study had three goals. The first goal was to determine whether background television would distract young children during an adult-child interaction. The data obtained from the frequency and duration of looks on- and off-task revealed that background television did distract three-year-olds from an adult-child interaction. During the Book Task, children who interacted with the adult in the presence of background television looked off-task more frequently and for a greater duration than children who did not experience the background television. During the Puzzle Task, the three-year-olds who experienced the background television looked off-task significantly longer than children who did not have the television on. In both cases, the majority of off-task looks were directed to the television. Under conditions of no distraction (i.e., no background television), children did not have multiple stimuli competing for their attention and therefore, they focused their attention on the task at hand as there were no other salient stimuli to capture their attention. Thus, they spent most of their time looking to task-related materials. However, when a distraction such as background television was present, there was competition for attentional resources. Therefore, the frequency and duration of looks off-task is a good measure of whether the child was distracted.

It was expected that the greater the duration and frequency of looks off-task, the greater amount of time that would be required to complete the tasks. However, this was the case for the Puzzle Task only. Children in the TV-On condition required more time to complete the Puzzle Task than children in the TV-Off condition. This longer duration to complete reflects the greater frequency and duration of off-task looks displayed by the three-year-olds in the TV-On condition compared to those in the TV-Off condition. The

time to complete the Book Task and its tests, however, did not differ in the presence and absence of television, despite children in the TV-On condition having a greater frequency and duration of looks off-task. This suggests that children who had the television on may have completed the task itself more quickly, but when the time spent looking off-task is included, they took just as long as those three-year-olds who were not in the background television condition. This seems to indicate that television affected the Book and Puzzle Tasks differently. The television distracted three-year-olds in the Puzzle Task, causing them to take longer to complete the task and to look off-task more than the children who did not experience the background television. For the Book Task, television seemed to reduce the time needed to read the book and do the tests, while also contributing to a greater duration of off-task looks. It is possible that the presence of background television motivated the children to finish the task quickly so they could continue watching television, as though the task did not matter. The opposite was true for the children in the TV-Off condition. The time spent on-task and off-task added to produce roughly the same total duration of time in the TV-On and the TV-Off conditions.

The distracting effect of television noted in this study replicates previous findings and extends them to include an older age group. As mentioned, there is evidence that television distracts infants during free play situations (Courage et al., 2010; Schmidt et al., 2008). Television was also distracting for the three-year-olds in the present study. While three-year-olds possess a much higher level of executive attention than infants, their executive attention is still undergoing development (Ruff & Rothbart, 1996; 2001). This study also shows that television can distract children from structured learning tasks rather than just the free play situations previously studied. Although by age three, goal-

directed executive attention is becoming more mature (Ruff & Rothbart, 1996; 2001), when given the adult-directed goal of completing two tasks, background television still captured their attention as though the tasks did not possess intrinsic motivation for the children.

Given that television has the ability to draw three-year-olds' attentional resources away from structured learning tasks, the second goal of the study was to determine what effect background television had on task performance. Task performance reflects what was learned during the interaction with the researcher. In the case of the Book Task, the presence of television had an adverse effect on three-year-olds ability to verbally recall details of the story: children in the TV-On condition were able to recall fewer correct details than those in the TV-Off condition. A possible explanation for the poorer verbal recall in the presence of the television is that the television program's story is also being verbally presented at the same time as the book is being read. Children do not necessarily need to be looking at the television to comprehend and to be able to report the details of a televised story (Pezdek & Hartman, 1983). So the televised story may have caused interference in the recall of the book story. It is also possible that children in the TV-On condition simply paid less attention to the book.

While television affected verbal recall in the Book Task, it had no effect on the Book Task sequence reconstruction components. Both measures of sequence performance, the number of target actions produced and the number of pairs of target actions produced did not differ in the presence and absence of television. However, the measure of target actions produced appears to have been too easy for three-year-olds as 41 of the 56 participants produced all five of the target actions. The likely reason for so

many children successfully producing all of the target actions is that the sequence involved constructing an Oscar the Grouch figure from *Sesame Street*. By three, most children realize that they have to put Oscar's head, arms, and legs on in order to build him. For the target actions measure, the order in which the children put Oscar together was irrelevant. They were scored on whether they completed the action, not what preceded the action. Producing pairs of target actions seemed to be more difficult for three-year-olds; only 11 successfully produced all four pairs of target actions in the required order. Number of pairs of target actions produced is a stricter criterion of sequence recall. For this measure of sequence performance, participants had to reproduce the actions in the exact order described in the book. So the children had to pay careful attention to the book as it was read to them. However, the presence of television still did not affect performance as children in the TV-On condition performed equally as well as those in the TV-Off condition. Therefore, it appears that in the Book Task at least, background television affects some types of learning (i.e., story recall) and performance but not others (i.e., serial order recall).

Television also did not affect performance in the Puzzle Task. Using the scoring method of either all correct or incorrect (i.e., some but not all correct), it was revealed that there were equal numbers of three-year-olds who completed the puzzle correctly and those who made errors in both the presence and absence of background television. The lack of difference between the TV-On and the TV-Off conditions is likely attributable to the ceiling effect observed in the Puzzle Task. Given that 28 of 56 participants inserted all six puzzle pieces correctly, the task was easy for three-year-olds and therefore, it is not surprising that the television had no effect. In some cases children have been observed to

perform as well or better under conditions of distraction (e.g., Poyntz, 1933; Turnure, 1970). This may be what happened in the Puzzle Task. The low degree of difficulty of the Puzzle Task for three-year-olds allowed for the children in the TV-On condition to attend to the television periodically while successfully completing the task. Furthermore, the low level of difficulty of Task 2 may have reduced the need for children to focus on the task in order to successfully complete the task. The relative ease of the Puzzle Task may have also affected the children's interest in the task. A low level of interest in the task may have made television viewing more attractive to the children.

An important part of achieving success on the Puzzle Task was understanding the need to look to the model puzzle to determine the correct location of each piece. A comparison of those three-year-olds who completed the puzzle correctly and those who completed the puzzle incorrectly revealed that looks to the model were key to success in the Puzzle Task. Children who finished the puzzle correctly looked to the model puzzle more than children who failed to complete it correctly. This is consistent with previous research using the puzzle task (Davis et al., 2004; Harris et al., 2007; Wertsch et al., 1980). Additionally, three-year-olds in the TV-On condition looked to the model more than those in the TV-Off condition. This likely reflects the television interrupting ongoing looks to the model. Once the look to the television is over, the children return to look at the model puzzle. This could be evidence of the television distracting the children, but where the Puzzle Task was so easy for the three-year-olds it did not influence performance. As long as they looked to the model, three-year-olds were able to complete the puzzle successfully regardless of whether the television was on or off.

While the presence or absence of background television could not explain the variation in three of four measures of task performance, executive functioning was able to provide some further insight into a possible reason for the variance in task performance. Executive functioning was investigated in the study's third goal and it is naturally expected that children who possess higher levels of executive functioning would perform better on tasks that require the use of skills considered to be executive functions. It is important to note that higher the score on the BRIEF-P, the poorer the executive functioning skills (there is a negative relationship). In the Book Task, the number of pairs of target actions produced during the reconstruction of the sequence was related to the Shift scale and the Emergent Metacognition Index of the BRIEF-P (Gioia et al., 2003). The Shift scale corresponds to the ability to make attentional transitions and flexibly adapt to solve a given problem (Gioia et al., 2003). With regards to the number of pairs of target actions produced, shifting is illustrated, for example, when the child has attached all of Oscar's body parts, he or she must transition from building Oscar to performing the remaining actions that involve placing Oscar in his garbage can, not attaching body parts. Children in the TV-On condition also specifically displayed the abilities subsumed under the Shift scale. As there was no difference in the number of pairs of target actions produced in the TV-On and the TV-Off conditions, children in the TV-On condition were successfully able to alternate their attention between the task and the television. In addition to the Shift scale, the Emergent Metacognition Index is also related to the number of pairs of target actions produced during the Book Task. The Emergent Metacognition Index represents the ability to maintain information in working memory and to use this information to plan and organize problem solving approaches (Gioia et al.,

2003) and is vitally important in the reconstruction of the sequence order depicted in the book. To complete the sequence successfully, the children must have retained the sequence order presented in the book in working memory and also be able to use this information in working memory and use it to guide how they will complete the sequence.

Children who completed the Puzzle Task test correctly differed from children who completed the puzzle test incorrectly on the raw scores of the BRIEF-P (Gioia et al., 2003), as well. Three-year-olds who failed to complete the puzzle correctly received higher scores on the Working Memory scale of the BRIEF-P (Gioia et al., 2003). The Working Memory scale represents the ability to hold information in mind that is to be used in the near future. Preschoolers utilize working memory to maintain problem solving related activities, carry out multistep activities, and follow instructions (Gioia et al., 2003). It is working memory that allows three-year-olds to keep the instructions and importance of looking to the model puzzle in mind. Considering the importance of looking to the model puzzle to success in the puzzle task test, working memory skills are essential and it is not surprising that three-year-olds who possess better working memory skills performed better in the Puzzle Task. The Plan/Organize scale also differed between those participants who completed the puzzle test correctly and those who did not. The plan aspect of the scale reflects the ability to anticipate future events and use this to plan a series of steps to complete a task (Gioia et al., 2003). Plan also refers to the ability to execute instructions. The organize component of the Plan/Organize scale represents the ability to use information to achieve a goal (Gioia et al., 2003). In the Puzzle Task, three-year-olds must implement the instructions to make their puzzle the same as the model puzzle, use the information obtained during the learning phase, and develop a sequence of

actions that will allow them to complete their goal of making their puzzle identical to the model. Given that the Working Memory and Plan/Organize (Gioia et al., 2003) scales differed between those who completed the puzzle correctly and those that completed it incorrectly, it is not surprising that the score on the Emergent Metacognition Index (Gioia et al., 2003) also differed between the two groups. The Emergent Metacognition Index (Gioia et al., 2003) is a summary of the processes behind the Puzzle Task. The children need to have temporarily stored the task's instructions and the importance of looking to the model in working memory, these points must be retrieved from working memory, and then used to organize and plan the placement of pieces.

There are several points worth noting about the present study. First, the distracting effects of television observed cannot be generalized beyond the research environment. While the research room was designed to be similar to a family room, it was an unfamiliar environment for the children in which they interacted with an unfamiliar individual. In most learning situations, the environment is familiar, whether it is a room in the child's home or a room in their preschool. Children also typically interact with individuals who are familiar to them, such as a parent or a teacher, in learning situations. While there was a greater duration of off-task looks in the TV-On condition, the TV-Off condition also had a high frequency of off-task looks. In the case of the TV-Off condition, the off-task looks were not concentrated on one item in the room, but rather varied throughout the room. So there is a possibility that the research setting itself was distracting for three-year-olds. Given the lack of familiarity with the situation in general, the distracting effects of television noted may be, in some way, partially

attributable to the novelty of the situation. Future research should examine this possibility.

A second point to be noted is that the television show used in the television condition was chosen because it was believed to be very attractive to three-year-olds. *The Backyardigans* is a popular show that is designed for preschoolers and is largely comprehensible to three-year-olds. Comprehension is important in determining attention to television (Anderson, Lorch, Field, & Sanders, 1981; Lorch, Anderson, & Levin, 1979; Pingree, 1986). Given the high degree of salience of the television show for three-year-olds and the use of only one television program, it is difficult to say whether the distraction observed in the present study would also occur if a less salient adult-directed show, such as a news program, a drama, or a soap opera, was on the television. An idea for future research would be to examine how preschoolers react if placed in a similar situation with adult-directed programs.

There were also a couple of issues with the tasks themselves. Participants were not given any time constraints when completing the tasks. While preschoolers are not typically subjected to time constraints as school-aged children are, a time limit may have produced a more pronounced effect on task performance since children in the TV-On condition did take longer to complete the Puzzle Task. It should be noted that participants were not asked to complete the tasks as quickly as possible. Future research should investigate whether time constraints influence performance under similar conditions. Additionally, some aspects of the tests may have been too difficult or too easy. For example, the ceiling effect in the Puzzle Task indicates that three-year-olds found this task relatively easy. It would have been more beneficial if the tasks were of

moderate difficulty. The present study also examined only two possible cognitive tasks and their outcome measures. It would be interesting to see whether television has the ability to influence other types of learning and task performance.

Ideally, there would have been an equal number of male and female participants in the present study. Unfortunately, this did not happen. The disproportionate number of females to males greatly reduced the statistical power of sex comparisons and may have masked sex differences. Future research should strive to have equal numbers of males and females in order to test for possible sex differences.

With regards to the effects of television on preschoolers, the results of the present study suggest several conclusions. Television does distract three-year-olds from interactions with an adult. This is evident in both the frequency and duration of looks off-task. However, this distraction does not affect all forms of learning and performance equally. The only form of performance observed to suffer under the influence of television was the verbal recall of the book's details. The two measures of performance for the Book Task sequence and the measure of Puzzle Task performance were not influenced by the presence of television. This suggests that specific characteristics of the tasks and the outcome measures may be important in understanding whether television can distract and impair learning. This is consistent with the research demonstrating that characteristics of the task influence whether distraction will occur (Doolittle & Ruff, 1998; Oakes et al., 2000; Oakes et al., 2002, Oakes & Tellinghuisen, 1994) and whether distraction impairs performance (Higgins & Turnure, 1984). In particular, children who possess better executive functioning skills seemed to be able to manage to perform at a high level regardless of whether the television was on or off.

Finally, the parent-completed television viewing questionnaire revealed another important point to consider. Foreground and background television was a constant presence in the homes of 46.3% of the participants and was still a significant presence in the lives of the other participants. Given television's common presence in the lives of three-year-olds, it is possible children are accustom to television being on while they are working at other activities. They may have simply become efficient at multitasking and are able to pay attention to the television and their activity concurrently. Referring back to Ruff and Rothbart's (1996) attentional framework, it may be the case that the three-year-olds in the present study may have habituated to television, in the sense that it no longer prevented them from focusing their attention to other stimuli while it was on. The implication here is that television captured children's attention, but the constant presence has allowed them to become efficient at not letting it interfere with simultaneously occurring activities. However, television does have the potential to interfere with some types of performance and this should be kept in mind when expecting a child to learn in the households of today where television is a constant presence.

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Appendix A

Recruitment brochure

This study has been granted approval from the Interdisciplinary Committee on Ethics in Human Research (ICEHR) at Memorial University.

Infant and Child Vision Research Centre
at
Memorial University of Newfoundland

Preschool Children and Television

Appendix B

Questionnaires used in study

BRIEF®-P

Behavior Rating Inventory of Executive Function–Preschool Version™

RATING FORM

Gerard A. Gioia, PhD, Kimberly Andrews Espy, PhD, and Peter K. Isquith, PhD

Instructions to Parents and Teachers

On the following pages is a list of statements that describe young children. We would like to know if the child has had *problems* with these behaviors *during the past 6 months*. Please answer *all the items* the best that you can. Please do not skip any items. Think about the child as you read these statements and circle:

N	if the behavior is	**Never** a problem
S	if the behavior is	**Sometimes** a problem
O	if the behavior is	**Often** a problem

For example, if having tantrums when told "No" is never a problem, you would circle **N** for this item:

Has tantrums when told "No" (N) S O

If you make a mistake or want to change your answer, ***DO NOT ERASE***. Instead draw an **X** through the answer you want to change and then circle the correct answer:

Has tantrums when told "No" (X) (S) O

Before you begin answering the items, please fill in the child's name, gender, age, and birth date, as well as your name, relationship to the child, and today's date in the spaces provided at the top of the next page. If you are the child's teacher or child care provider, please check the box next to the response that best describes how well you know the child and indicate how long you have known the child in the space provided.

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Child's Name _____ Gender _____ Age _____ Birth Date ___/___/___

Your Name _____ Today's Date ___/___/___

Relationship to Child: ☐ Mother ☐ Father ☐ Teacher* ☐ Other* _____

How well do you know the child? ☐ Not Well ☐ Moderately Well ☐ Very Well *Have known the child for____ ☐ months ☐ ye

During the past 6 months, how often has each of the following behaviors been a *problem?*

	Never	Sometimes	Often
1. Overreacts to small problems	N	S	O
2. When given two things to do, remembers only the first or last	N	S	O
3. Is unaware of how his/her behavior affects or bothers others	N	S	O
4. When instructed to clean up, puts things away in a disorganized, random way	N	S	O
5. Becomes upset with new situations	N	S	O
6. Has explosive, angry outbursts	N	S	O
7. Has trouble carrying out the actions needed to complete tasks (such as trying one puzzle piece at a time, cleaning up to earn a reward)	N	S	O
8. Does not stop laughing at funny things or events when others stop	N	S	O
9. Needs to be told to begin a task even when willing to do it	N	S	O
10. Has trouble adjusting to new people (such as babysitter, teacher, friend, or day care worker)	N	S	O
11. Becomes upset too easily	N	S	O
12. Has trouble concentrating on games, puzzles, or play activities	N	S	O
13. Has to be more closely supervised than similar playmates	N	S	O
14. When sent to get something, forgets what he/she is supposed to get	N	S	O
15. Is upset by a change in plans or routine (for example, order of daily activities, adding last minute errands to schedule, change in driving route to store)	N	S	O
16. Has outbursts for little reason	N	S	O
17. Repeats the same mistakes over and over even after help is given	N	S	O
18. Acts wilder or sillier than others in groups (such as birthday parties, play group)	N	S	O
19. Cannot find clothes, shoes, toys, or books even when he/she has been given specific instructions	N	S	O
20. Takes a long time to feel comfortable in new places or situations (such as visiting distant relatives or new friends)	N	S	O
21. Mood changes frequently	N	S	O
22. Makes silly mistakes on things he/she can do	N	S	O
23. Is fidgety, restless, or squirmy	N	S	O
24. Has trouble following established routines for sleeping, eating, or play activities	N	S	O
25. Is bothered by loud noises, bright lights, or certain smells	N	S	O
26. Small events trigger big reactions	N	S	O
27. Has trouble with activities or tasks that have more than one step	N	S	O
28. Is impulsive	N	S	O
29. Has trouble thinking of a different way to solve a problem or complete an activity when stuck	N	S	O
30. Is disturbed by changes in the environment (such as new furniture, things in room moved around, or new clothes)	N	S	O

During the past 6 months, how often has each of the following behaviors been a *problem?*	Never	Sometimes	Often
31. Angry or tearful outbursts are intense but end suddenly	N	S	O
32. Needs help from adult to stay on task	N	S	O
33. Does not notice when his/her behavior causes negative reactions	N	S	O
34. Leaves messes that others have to clean up even after instruction	N	S	O
35. Has trouble changing activities	N	S	O
36. Reacts more strongly to situations than other children	N	S	O
37. Forgets what he/she is doing in the middle of an activity	N	S	O
38. Does not realize that certain actions bother others	N	S	O
39. Gets caught up in the small details of a task or situation and misses the main idea	N	S	O
40. Has trouble "joining in" at unfamiliar social events (such as birthday parties, picnics, holiday gatherings)	N	S	O
41. Is easily overwhelmed or overstimulated by typical daily activities	N	S	O
42. Has trouble finishing tasks (such as games, puzzles, pretend play activities)	N	S	O
43. Gets out of control more than playmates	N	S	O
44. Cannot find things in room or play area even when given specific instructions	N	S	O
45. Resists change of routine, foods, places, etc.	N	S	O
46. After having a problem, will stay disappointed for a long time	N	S	O
47. Cannot stay on the same topic when talking	N	S	O
48. Talks or plays too loudly	N	S	O
49. Does not complete tasks even after given directions	N	S	O
50. Acts overwhelmed or overstimulated in crowded, busy situations (such as lots of noise, activity, or people)	N	S	O
51. Has trouble getting started on activities or tasks even after instructed	N	S	O
52. Acts too wild or out of control	N	S	O
53. Does not try as hard as his/her ability on activities	N	S	O
54. Has trouble putting the brakes on his/her actions even after being asked	N	S	O
55. Unable to finish describing an event, person, or story	N	S	O
56. Completes tasks or activities too quickly	N	S	O
57. Is unaware when he/she does well and not well	N	S	O
58. Gets easily sidetracked during activities	N	S	O
59. Has trouble remembering something, even after a brief period of time	N	S	O
60. Becomes too silly	N	S	O
61. Has a short attention span	N	S	O
62. Plays carelessly or recklessly in situations where he/she could be hurt (such as playground, swimming pool)	N	S	O
63. Is unaware when he/she performs a task right or wrong	N	S	O

MacArthur-Bates Communicative Development Inventory-III

Child's name: _____ Birthdate: _____ Gender: _____

Person completing form (relationship to child): _____ Today's date: _____

VOCABULARY CHECKLIST

Children understand many more words than they say. We are particularly interested in the words your child SAYS. Please mark the words you have heard your child use. If your child uses a different pronunciation of a word, mark it anyway. This is only a sample of words; your child may know many other words not on this list.

○ dinosaur	○ glass	○ catch	○ peculiar
○ donkey	○ jar	○ drop	○ before
○ reindeer	○ ladder	○ fasten	○ then
○ castle	○ material	○ forget/forgot	○ today
○ drum	○ stamp	○ hate	○ week
○ football	○ tire	○ hurry	○ yesterday
○ microscope	○ furniture	○ leave	○ their
○ tricycle	○ kitchen	○ measure	○ they
○ kite	○ sofa/couch	○ peel	○ those
○ wagon	○ cloud	○ promise	○ yourself
○ lemon	○ fence	○ skate	○ why
○ peanut	○ hose	○ sneeze	○ about
○ cracker	○ sidewalk	○ somersault	○ above
○ salt	○ zoo	○ think	○ away
○ sauce	○ child	○ black	○ between
○ vanilla	○ cowboy	○ bored	○ on top of
○ vegetable	○ family	○ deep	○ each
○ beads	○ farmer	○ different	○ every
○ jeans	○ nobody	○ empty	○ none
○ elbow	○ nurse	○ expensive	○ might
○ (finger)nail	○ accident	○ fine	○ need to
○ thumb	○ circle	○ half	○ were
○ bandaid/bandage	○ front	○ long	○ although
○ blade	○ idea	○ lost	○ because
○ computer	○ camping	○ angry	○ however

Has your child begun to combine words yet, such as "'nother cookie" or "doggie bite?"

○ Not Yet ○ Sometimes ○ Often

If you answered "Not Yet," please stop here. If "Sometimes" or "Often," please turn the page.

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Sentences

For each pair of sentences below, mark the one that sounds MOST like the way your child talks at the moment. If your child is saying sentences even more complicated than the two provided, mark the second one.

1. (Talking about something that already happened)
   - ○ Daddy pick me up.
   - ○ Daddy picked me up.
2. ○ That my truck.
   - ○ That's my truck.
3. ○ Coffee hot.
   - ○ That coffee hot.
4. ○ I like read stories.
   - ○ I like to read stories.
5. ○ Don't read book.
   - ○ Don't want you read that book.
6. ○ Why he run away?
   - ○ Why did he run away?
7. ○ He did it.
   - ○ I know who did it.
8. ○ We got to go now.
   - ○ I think we got to go now.
9. ○ I want truck.
   - ○ I want truck like Tommie has.
10. ○ This dolly big.
    - ○ This dolly big and this dolly little.
11. ○ This pig have a broken leg.
    - ○ This pig have a broken leg but kitty don't.
12. ○ It got broken.
    - ○ It got broken by the car.

Using Language

	YES	NO
1. Does your child understand the concept of "one"? If you ask for just one (cookie, strawberry, etc.), will your child give you only one and then stop?	○	○
2. Does your child ask questions with more than one word that begin "what" or "where"?	○	○
3. Does your child ask questions with more than one word that begin "why" or "how"?	○	○
4. Does your child give reasons for things using the word "because"?	○	○
5. If you asked your child "What is a horse?", could he/she answer "an animal"?	○	○
6. Can your child name simple shapes with the words "circle," "square," and "triangle"?	○	○
7. Does your child talk about things that "could" or "might" happen, such as "he could hurt himself if he's not careful"?	○	○
8. Does your child ever ask what a particular word means?	○	○
9. Could your child tell you which of two objects is larger if they were not present—for example, "which is bigger, a horse or a dog"?	○	○
10. Does your child know his/her right hand from his/her left hand?	○	○
11. Does your child use "-est" words such as "biggest" and "strongest"?	○	○
12. Can your child answer questions such as "what do you do when you are hungry?" and "what do you do when you are tired?" with appropriate answers such as "get food," "eat," "go to sleep," and/or "take a nap"?	○	○

Examples: Please list three of the longest sentences you have heard your child say recently.

1. _____
2. _____
3. _____

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Television Viewing and Demographic Information Questionnaire

1. On an average day how much time does your child spend watching TV?

   _____

2. How much of this time are you watching with your child?

The Whole Time	Most of the Time	About Half the Time	Less than Half of the Time	Not at All

3. When someone is at home in your household, how often is the TV on, even if no one is actually watching it?

   Never Rarely Sometimes Often Always

4. Does your child have a TV in his or her bedroom?

   Yes No

5. In your view is children's TV programming most effective for

   Learning Entertainment Both Neither

6. In your view does children's TV programming

Interfere with Play	Takes Time Away from Social Interactions	Both	Neither

7. How often does your child watched *The Backyardigans* TV program?

   Never Rarely Sometimes Often Always

8. How many times has your child watched this particular episode of *The Backyardigans*? (Give your best estimate) _____

9. How often do you read to your child?

Daily	Several Times a Week	Weekly	Rarely

10. What is your highest level of education?

a) High School Completion
b) Some Post Secondary
c) Completed Trade or Technical Program
d) University Degree

11. How many brothers and sisters does your child have? ____

Appendix C

Information letter and consent form

Study Information and Consent to Participate

The effect of background television on attention and learning in 3-year-old children

Dear parent(s) or guardian(s):

The *Infant and Child Vision Research Centre* is conducting a study to examine whether the presence of a television program distracts children's attention from other activities. Despite the increasing prevalence of young children's exposure to television, there is little known about the effects of this exposure during learning activities. We hope that the results of this study will help fill this gap in the research literature and will provide parents with some of the information necessary to make informed choices regarding their children and television.

Today's experimental session will involve two tasks: a puzzle task and a book task. For the puzzle task the researcher will help your child complete two puzzles by referring to a model puzzle. One of the puzzles is simply a practice puzzle to ensure the task is understood. Upon completion of the main puzzle, a test of your child's interest in the puzzle will be conducted. The book task will involve the researcher reading a short book to your child. Following the reading, your child's recall of details in the story will be assessed. For some participants the television will be on while the tasks are being completed. You will be asked to complete several questionnaires assessing your child's language skills, executive functioning, and television viewing habits. The entire session may take up to 45 minutes to complete.

During the session, your child's attention to the tasks and television will be examined. For this reason, you and your child will be videotaped, so we can examine what your child is looking at and how he or she is completing the tasks.

You will be with your child at all times during the study. The materials used in each task are age appropriate and the television program will not contain any disturbing images or sounds. The study can be stopped at any time upon your request. The results of the study will be used to fulfill thesis requirements and maybe used in academic publications or conference presentations. Each child's performance is confidential and no individual child will be identified in the reporting of results. However, your child's results can be made available to you at anytime.

The proposal for this research has been reviewed by the Interdisciplinary Committee on Ethics in Human Research and found to be in compliance with Memorial University's ethics policy. If you have ethical concerns about the research (such as the way you have been treated or your rights as a participant), you may contact the Chairperson of the ICEHR at icehr@mun.ca or by telephone at (709) 737-8368.

If you have any questions or would like a copy of the research results, please feel free to contact Dr. Mary Courage at 737-8027 or Stephanie Goulding at 728-7284. If you wish to have your child participate, please complete the information below. Thank you.

Yours truly,

Stephanie Goulding, M.Sc. Candidate

I have read the above description of the study entitled "The effect of television on learning during adult-child interactions." I understand that by signing this form, I have given consent for my son/daughter to participate, and I can withdraw our participation at any time.

Child's Name: _____

Date: _____

Child's Birth Date: _____

Parent's Name: _____

Parent's Signature: _____

Email Address: _____