What preschoolers bring to the show: The effects of cognitive abilities and viewer characteristics on children’s learning from educational television

THESIS

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By

Fashina Aladé

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Master's Examination Committee:

Amy Nathanson, Advisor

Emily Moyer-Gusé

David Ewoldsen
Abstract

The capacity model (Fisch, 2000, 2004) is one of the few existing theoretical models developed to explain how children learn from educational television, but it has yet to receive much empirical attention. This goal of this correlational study was to investigate the role of the viewer characteristics described in the capacity model. One-on-one testing sessions were conducted with 78 children between the ages of three and five years old, in which the researcher administered assessments of verbal ability, short-term memory, interest, and prior knowledge. Participants then viewed a short episode of an educational TV program, and, finally, completed story schema and comprehension assessments. Regression analyses revealed that short-term memory, story schema development, and prior knowledge related to the narrative were positively associated with narrative comprehension, and prior knowledge related to the educational content was positively associated with educational content comprehension. Additionally, narrative comprehension was found to mediate the relations between certain viewer characteristics and educational content comprehension, supporting the principle of narrative dominance. Verbal ability was not significantly related to narrative comprehension, and interest was not significantly related to either narrative comprehension or educational content comprehension. Results provide an important step in theorizing about children’s learning from educational television, but indicate that more research is needed to come to a conclusion about the usefulness of the capacity model.
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Vita

2007........................................................Communications High School of Wall, NJ

2011........................................................B.A. Communication, Magna Cum Laude, University of Pennsylvania

2011-2012 ................................................Graduate Enrichment Fellow, The Ohio State University

2012 to present ...........................................Graduate Teaching Associate, School of Communication, The Ohio State University

Fields of Study

Major Field: Communication
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What preschoolers bring to the show: The effects of cognitive abilities and viewer characteristics on children’s learning from educational television

For the past several decades, scholars and commercial producers alike have been increasingly interested in the various effects, both positive and negative, that television may have on society (Nabi & Oliver, 2010), especially on the youth (Wartella, 1999). Recent estimates suggest that sixty-six percent of children birth through age six watch television every day, with preschoolers being among the highest viewers (Rideout & Hamel, 2006). Unsurprisingly, “educational television” for preschoolers has become very popular in the commercial lineup. Parents view this as a relatively harmless, and perhaps even educational, way to keep their young children entertained (D. Hayes, 2008). As a result, several cable channels are devoted exclusively to preschool programming. Because educational television can have a great impact on school-readiness skills (Anderson, Huston, Schmitt, Linebarger, & Wright, 2001), which can impact development later on, there is a great need for understanding how preschoolers learn from this popular type of television.

From a social psychological perspective, some scholars suggest that children do not just respond to media, but also bring their own perceptions and attributions to the viewing experience, which affects their individual experience with the medium. Salomon (1983) writes, “Children actively influence the way they experience the medium, not just
through the skills and knowledge the medium evokes, but also through their a priori metacognitions, metascripts, or metarules that they apply to it” (p. 195). This suggests that in order to gain a full understanding of children’s comprehension of television, researchers must consider not only the characteristics of the program, but also the characteristics of the viewers. This study seeks to test a theoretical model of children’s learning from educational television with a focus on the viewer characteristics that affect comprehension of the narrative and of the educational content.

**What is Educational Television?**

Despite the claims of some (e.g., Healy, 1990; Winn, 1977), *educational television* is not an oxymoron (Anderson, 1998). Empirical research has shown that when developmentally appropriate content is coupled with entertaining program formats, children benefit. This has been shown across a host of educational outcomes including school readiness (Anderson, et al., 2001), literacy skills (Linebarger, Kosanic, Greenwood, & Doku, 2004), mathematics skills (Fisch & McCann, 1993), science skills (Dingwall & Aldridge, 2006), and prosocial skills (Mares & Woodard, 2005).

Over the years, numerous terms have been used to refer to television programs that are intended to educate or benefit children, and these terms are often used to describe a wide array of programming (Fisch, 2004). After much debate over what should and should not be included in this genre, the Federal Communications Commission (FCC) created the Children’s Television Act of 1990, which defined “educational/informational” programming as content that will “further the positive development of the child in any respect, including the child’s cognitive/intellectual or emotional/social needs” (FCC,
1991). This broad definition left room for a multitude of interpretations, and, although the Act was strengthened in 1996, requiring all children’s television channels to air educational programs, the FCC chose not to narrow the definition.

Despite diverse definitions, it is generally agreed that educational television serves as a form of informal education. Unlike formal education, which occurs in the classroom, informal education takes place outside of school, involves experiences that are not part of a school curriculum, and often must compete with other activities to gain children’s attention and engagement. Fisch (2004) explains that educational television is intended to supplement formal education in the following ways: (1) by exposing children to topics that they might not otherwise encounter; (2) by providing compelling experiences that encourage children to spend additional time exploring concepts that they are learning about in school; (3) by encouraging positive attitudes toward academic subjects, especially among populations that are less likely to pursue those subjects on their own; and (4) by motivating children to engage actively in learning both inside and outside of the classroom.

Although the potential for television to facilitate informal education has been well established, educational programs have greatly varying degrees of success (Anderson, 1998; Thakkar, Garrison, & Christakis, 2006). It is not only the content of an educational program that dictates its effectiveness. A long line of research on the formal features of television has, for instance, demonstrated that program attributes like action, pace, visual techniques such as zooms, cuts, and special effects, and auditory features such as music, dialogue, and sound effects can have a significant effect on children’s attention to and
comprehension of educational television (John C. Wright & Huston, 1983). This type of research has the potential to lead to the production of more research-driven, educationally beneficial television for children. However, most shows for children do not actually use these empirical findings to guide their production. Given the wide array of quality in children’s educational programs, the question remains: how can we help our children navigate through the plethora of “educational” programs in a way that allows them to soak up the most knowledge? One key is to have a better understanding of what the children themselves bring to the viewing experience.

**How children learn from television – A theoretical model**

Although the existing literature highlights that children can learn from television, explanations as to how children learn from television are limited. In response to the dearth of theoretical explanations available, Fisch (2000, 2004) put forth the capacity model to explain how children extract and comprehend educational content from television programs. Central to the model is the supposition that working memory is limited. If the demands of processing a television program exceed the capacity of working memory, comprehension is impaired. The demands of processing are compounded by the nature of the medium itself. Unlike reading, the viewer’s experience with television involves processing both auditory and visual information at the same time, and it is not self-paced. Instead, the viewer’s processing must be employed in a way that fits the pace of the program (Fisch, 2000, 2004).

According to the model, there are three things that affect the allocation of working memory resources when children watch educational television: 1) processing of the
narrative, 2) processing of educational content, and 3) the distance between the educational content and the narrative. Narrative content is defined as the story or plot of the program, whereas educational content is defined as the underlying educational concept or message that the program is intended to convey. Distance refers to the degree to which the educational content is integrated with or tangential to the story. For example, a program about animals that sporadically cuts to an unrelated lesson about shapes would be considered to have high distance. A program, on the other hand, in which the main characters have to learn about shapes in order to accomplish their story goal would be considered to have low distance. According to the model, this concept of distance has great implications for children’s learning. When the educational content is tangential to the central narrative of the program (i.e., high distance), the two parallel processes of comprehension compete for limited resources in working memory. The result is that the educational content cannot be processed as deeply as it otherwise might be, and comprehension is likely to be impaired. On the other hand, when the distance between the two types of content is small, the two parallel processes become complementary, and comprehension is likely to be strengthened.

The capacity model operates under three governing principles. The first is the principle of narrative dominance, which says that priority is given to comprehension of narrative over educational content. Because the primary purpose of watching television is usually for entertainment, and because the entertainment value of a program usually lies in the narrative, Fisch argues that children will allocate resources to processing the narrative first and foremost.
Following the principle of narrative dominance, the second governing principle says that the amount of resources available for processing educational content is directly a function of the resources necessary for processing the narrative. When these parallel processes are in competition with each other, the model predicts that preference will be given to narrative processing, and comprehension of the educational content will suffer. Thus, educational content comprehension is largely dependent upon narrative content comprehension. The third governing principle, however, reminds us that resources can be allocated voluntarily between the two processes. Although the default may be narrative dominance, certain motivational factors can influence viewers to allocate resources differently.

Fisch describes two categories of factors that influence children’s processing of educational television, (1) program characteristics and (2) viewer characteristics. The following program characteristics are highlighted within the capacity model: complexity of the story, need for inferences, clarity of presentation, explicitness of content, temporal organization, and use of advance organizers. The viewer characteristics that are said to reduce the demands of processing include prior knowledge, story schemas, knowledge of formal features, interest, verbal reasoning ability, and short-term memory. Fisch explains that in contrast to narrative processing, there has been little research done to investigate processing of educational content. Thus, his predictions about educational content processing are highly speculative and based mostly on the narrative processing literature.

To date, there have been only two empirical tests of Fisch’s capacity model. Nichols (2011) tested the effects of distance and pace within the framework of the
capacity model. She manipulated the pace of the program and the distance between the narrative and educational content in programs for 3 to 5-year-olds and found that slow pace and low distance resulted in greatest comprehension of both narrative and educational content. This study was an important first step in testing some of the major tenets of the capacity model, however it focused solely on program characteristics and did not test any of the viewer characteristics presented in the model.

Piotrowski (2012) tested one viewer characteristic presented in the model. She found that story schema development was a positive predictor of comprehension of both narrative and educational content. Children with greater story schema skills were more easily able to comprehend the narrative content, which in turn allowed for greater allocation of resources to processing the educational content. Although this study showed strong support for one prediction of the capacity model, it left many other predictions untested. One goal of the present study is to extend this line of research by more thoroughly testing the predictions of the capacity model.

Throughout the area of educational television research, a fairly extensive amount of research has been done to investigate the program characteristics that influence comprehension (e.g., Calvert, Huston, & Wright, 1987; van den Broek, Lorch, & Thurlow, 1996). As mentioned previously, one such line of research is based on the formal features of television. Overall, it is quite clear that the presentation of information can have a great impact on how that information is received and processed. However, program characteristics provide only one half of the story. Despite the efforts of the most informed writers and producers, even a well-designed program can result in vastly
different levels of comprehension among viewers. Differences in the viewers themselves must therefore be an important part of the equation.

The focus of the current study is on the viewer characteristics presented in the capacity model, with the goal of obtaining a better understanding of the individual differences in children that influence comprehension. Fisch categorizes the viewer characteristics by differentiating characteristics that affect processing of the narrative from characteristics that affect processing of the educational content. However, these categories are rather redundant. A more meaningful distinction would be to separate the viewer characteristics into general cognitive abilities and program-specific viewer characteristics. There is a sizeable amount of support for the idea that general cognitive and developmental abilities affect comprehension of educational television (e.g., Collins, 1975; Jacobvitz, Wood, & Albin, 1991; Michel, 2010); however, the program-specific viewer characteristics have yet to receive much attention. The present study will investigate whether or not the program-specific viewer characteristics affect comprehension above and beyond general cognitive skills. The following is a detailed overview of the viewer characteristics proposed by the capacity model that will be tested in the present study.

**Viewer Characteristics: General Cognitive Abilities**

**Verbal ability.** Fisch (2000, 2004) explains that there are a few general cognitive abilities that reduce the demands of processing narrative. One such skill is verbal ability. Eckhardt, Wood, and Jacobvitz (1991) explain that verbal ability affects comprehension by facilitating lexical processing. In a study of adults’ comprehension of televised
narratives, they found that verbal ability was the best predictor of immediate comprehension of the program. Viewers low in verbal ability must allocate a large amount of resources to processing the lexical content of the program, particularly when the pace of the program is not optimal. Viewers high in verbal ability, on the other hand, benefit from automaticity of processing lexical content, and therefore can devote more working memory resources to higher-level comprehension such as inference-making, elaboration, and integration.

Specifically, as it relates to children and television, Jacobvitz, Wood, and Albin (1991) posited that basic cognitive abilities might account for the variance in comprehension that was often found in children of the same age group. In a study that investigated five-year-olds’ comprehension of an “age-appropriate” television show, they found that verbal ability accounted for 42% of the variance in comprehension of the central content of the program. This suggests that children with better verbal skills are able to spend fewer resources on processing verbal information, leaving more resources available for processing the narrative, which brings us to the first hypothesis addressed in this study.

**H1: Verbal ability will be positively correlated with comprehension of the narrative.**

**Short-term memory.** Like verbal ability, short-term memory is a general cognitive ability (Baddeley, Thomson, & Buchanan, 1975) that Fisch predicts will increase comprehension by facilitating more efficient use of working memory resources. Studies in developmental psychology have found short-term/working memory skills to be
strong predictors of early learning. For instance, Gathercole, Pickering, Knight, and Stegmann (2004) found that seven-year-olds’ achievement in English and mathematics were significantly associated with working memory scores. This finding has been extended to preschool-age children as well. For example, Alloway et al. (2005) found that phonological short-term memory was a strong predictor of reading, speaking, and listening skills in children between the ages of four and five. Gathercole et al. (2004) explain that the intellectual processes required for learning academic content are constrained by the general capacity of working memory. Two children who share the same learning environment and opportunities may differ greatly in knowledge and aptitude. This difference is based in large part on their basic cognitive capacities to learn, including working memory.

Moreover, due to the visual nature of television, viewers’ ability to process visual information plays a large role in the allocation of working memory resources (Jacobvitz, et al., 1991). In investigating the effect of cognitive skills on comprehension of a televised narrative, Jacobvitz et al., (1991) found that second to verbal skills, visual short-term memory skills were the next best predictor of comprehension. Children with highly developed short-term memory skills were able to allocate fewer resources to recalling the story events, and were therefore able to allocate more working memory resources to higher-level comprehension. Thus, the expectation here is that by increasing overall capacity to learn and decreasing the demands of processing visual content, short-term memory skills should facilitate processing of narrative content.

**H2: Short-term memory skills will be positively correlated with comprehension of**
Story schema. Another important viewer characteristic that can be grouped with these general cognitive abilities is the existence of story schema, or familiarity with the typical structure of stories. Story schema theory is based on the underlying assumption that there is a prototypical story grammar that is present in most narratives. The more closely a story corresponds to the prototypical story structure, the more easily people are able to understand and recall the story (Thorndyke, 1977). It therefore stands to reason that the more familiar a reader is with the prototypical story structure, the more easily the reader will be able to understand and recall a story that matches that prototypical structure.

Mandler and Johnson (1977) defined story schema as “an idealized mental representation of the parts of a typical story and the relationships among those parts… that serves to facilitate both encoding and retrieval” (p. 111-112). They explain that the development of story schema comes from two sources: 1) listening to many stories and growing accustomed to the typical sequencing of events, including how they typically begin and end, and 2) real-world experience and knowledge about causal relations and various kinds of action sequences. In a developmental study of story recall, the researchers found that story schemas aid in comprehension and recall of aurally presented narratives for both children and adults (Mandler & Johnson, 1977).

Meadowcroft and Reeves (1989) conducted one of the first studies investigating the influence of story schema development on children’s attention to television. The authors explained that in text-based studies such as that of Mandler and Johnson (1977),
story schema was found to a) guide attention and help readers anticipate story content, b) aid in the hierarchical storage of information according to its importance, and c) make processing more efficient by providing a framework for organizing incoming information. They hypothesized that this would hold true for televised narratives as well. The study was conducted with children between the ages of 5 and 8 years old. Participants watched commercial television programs and were tested for story schema development, attention to the program, and memory of the story content. The authors indeed found that advanced story schema skills were related to reduced processing effort, increased memory for narrative, and greater flexibility in the allocation of working memory resources across concurrent tasks.

Due to the capacity for story schema to influence allocation of working memory resources, Fisch includes this characteristic in the capacity model (2000, 2004), predicting that advanced story schema skills will reduce the effort required to process the narrative. As mentioned earlier, Piotrowski (2012) did find support for this prediction. Importantly, unlike Meadowcroft and Reeves, who used entertainment programs for their stimuli, Piotrowski assessed the influence of story schema in understanding content from preschool-targeted educational programs. She found that demands of processing the narrative were reduced for children who had highly developed story schema skills. While Piotrowski (2012) investigated story schema alone, this study seeks to replicate those findings alongside the other predictions of the capacity model.

\[H3: \text{Development of story schemas will be positively correlated with comprehension of the narrative.}\]
Program-Specific Viewer Characteristics

**Prior knowledge.** One viewer characteristic described in the capacity model is the viewers’ prior knowledge of subject matter related to the program. Familiarity with certain situations and settings can facilitate comprehension of new information that matches easily into that prior knowledge structure. In a study of televised narratives, Newcomb and Collins (1979) found that children’s comprehension was enhanced when their ethnic and social class background matched that of the characters and situations portrayed in the program. They explain that “comprehension difficulties of young grade school children may reside partly in these children’s lack of familiarity with the types of roles, characters, and settings, portrayed in adult entertainment programs.”

Spilich, Vesonder, Chiesi, & Voss (1979) similarly reported that previously acquired knowledge affects the processing of new information within the same domain. In a study of textual narratives, they found that baseball fans were better able to recall central information from a story about a baseball game than non-fans. They state that the primary assumption in explaining these findings is that the processing of new information consists of a matching procedure in which the new information is matched to the individual’s existing knowledge structure.

Prior knowledge is highly related to literature on *scripts and schema* – organizational knowledge structures that guide encoding, storage, and retrieval. Adams and Worden (1986) define a schema as “an active, natural, generic knowledge structure that guides the comprehender's interpretation of input information, inference generation, and hence expectations of future input” (p. 150). A script is a certain type of schema that
is defined as “a knowledge structure that corresponds to frequently enacted and conventional activities that are made up of a series of appropriate events” (Adams & Worden, 1986, p. 150).

Several studies have found that very young children rely on these scripts and schemas for comprehension and inference-making. In a study of preschool and first-grade children, Hudson and Slackman (1990) found that participants were better able to use their general event knowledge, organized as schema or scripts, to make inferences about familiar events referred to in a textual narrative than to make logical or invited inferences that needed to be inferred directly from the text. Collins and Wellman (1982) investigated preschool and grade school children’s errors in comprehension of commercial television dramas. They found that although older children’s comprehension errors were usually based on confusion about the story events themselves, preschool age children’s comprehension errors were more likely to reflect stereotypical scripts cued by familiar sequences in events in the television program.

These studies support the idea that preschool children rely very heavily on prior knowledge, or scripts and schema, for comprehension of story events. Fisch (2000, 2004) predicts that this will hold true for preschoolers and educational programming. The existence of prior knowledge related to some aspect(s) of the program will allow the content to be assimilated into memory more easily, thus reducing the demands of processing.

Importantly, prior knowledge is predicted to have an effect on both narrative processing and processing of the educational content. Existing knowledge structures that
are related to the narrative content of the program should facilitate the comprehension of the story events of the stimulus narrative by providing a mental model on which to map the new events. For example, Eckhardt et al. (1991) found that adult viewers’ delayed recall of the story events presented in a televised drama about the Underground Railroad increased as a function of their prior knowledge about that topic. This finding is expected to hold true with young children as well.

\textit{H4a: Prior knowledge related to narrative will be positively correlated with comprehension of the narrative.}

Just as prior knowledge of the narrative content should increase comprehension of the narrative, so should prior knowledge related to the educational content increase comprehension of the educational material. This prediction has not yet been tested, but following the logic of the aforementioned studies, a knowledge base on which to map related material should facilitate learning of new information. For example, a child who has some foundational knowledge of counting and numeracy should be more able to process a simple mathematics lesson embedded in a television program than a child who does not have a basic command of numbers.

\textit{H4b: Prior knowledge related to the educational content will be positively correlated with comprehension of the educational content.}

\textbf{Interest.} While the previous factors are expected to increase comprehension by reducing processing demands, Fisch (2000, 2004) predicts that viewers’ \textit{interest} in the program will increase comprehension by increasing the overall allocation of resources to processing the program. This prediction is dependent upon the third governing principle
of the capacity model, which states that viewers can voluntarily allocate working memory resources to processing educational and/or narrative content if some factor influences them to do so.

Before discussing the relationship between interest and comprehension, it is first necessary to gain a better idea of what interest means. This is especially complicated because interest is not a commonly used construct within media research, but a few investigations of the concept have been conducted. For example, Chew and Palmer (1994) studied interest in the context of the knowledge gap hypothesis, which addresses the acquisition of new technologies for high-income populations versus low-income populations (Tichenor, Donohue, & Olien, 1970). One of Chew and Palmer’s main arguments was that interest in a particular topic determines attention to information about that topic, and that interest could, therefore, stabilize knowledge gaps between various populations. They identified three dimensions of interest: (1) cognitive, i.e., an individual’s perception of a topic as relevant; (2) affective, i.e., strength of feelings towards a topic; and (3) behavioral, i.e., the extent of involvement in activities related to the topic. (However, in their operationalization of the concept, they used only the affective and behavioral dimensions.) They found that participants’ interest in health and fitness was a strong predictor of knowledge gain from a health-related television program. However, the researchers did not give much of an explanation as to why this effect was observed.

In a different line of research, Ainley, Hidi, and Berndorff (2002) conceptualized interest as a psychological state characterized by increased attention, concentration, and
affect. It is often accompanied by an enduring predisposition to reengage with a particular object, event, or idea (Hidi, 2006). Using this definition, the researchers have found links between interest and learning in children. For example, in a study of eighth and ninth grade students using science texts, topic interest was found to be a predictor of persistence with a text, which was, in turn, a strong predictor of learning.

Although Ainley, Hidi, and Berndorff provided a good starting point for investigating interest in children, looking at interest as it manifests in preschool-age children poses a particular challenge because of their limited vocabulary compared to older children and adults. With young children, it becomes especially important to distinguish interest from liking. Although the concepts seem very similar superficially, for the purposes of this study, interest will be defined as a state that elicits increased attention towards an object, regardless of positive or negative valence. Something that is interesting to a viewer is something that feels personally relevant or important to them. More explicitly, interest will be conceptualized as the desire to engage and/or interact with a particular object, person/character, or activity.

Similar to prior knowledge, Fisch predicts that interest can reduce the demands of processing both narrative and educational content. For example, if a child who is interested in solving mysteries comes across a mystery-themed television program, he/she will allocate more resources to processing the narrative than a child who does not have that particular interest.

*H5a: Interest in narrative content will be positively correlated to comprehension of the narrative.*
Just as interest in the narrative should increase allocation of resources to processing the narrative, interest in the educational content should increase allocation of resources to processing that educational content. For example, a child who is interested in learning about animals will more easily learn new information about animal habitats than a child who is not particularly interested in this topic. In a study of school-age children, Renninger (1998) found that interest in mathematics resulted in greater performance on mathematical word problems. This has not yet been tested with televised educational content, but the capacity model predicts that the relationship will hold true.

\[ H5b: \text{Interest in the educational content will be positively correlated with comprehension of the educational content.} \]

There may also be an effect of general interest in watching television on children’s comprehension. Salomon (1983) found that children’s comprehension of both print and audiovisual media was associated with their amount of invested mental effort (AIME). Fisch (2000, 2004) explains that this construct is very similar to the amount of working memory resources that are allocated to processing the program overall. Perhaps some children have a natural inclination for watching television, or for watching the particular type of television represented by the stimulus episode. In this case, they would voluntarily allocate more resources to processing the content, resulting in greater comprehension of both narrative and educational content.

\[ H5c: \text{Interest in watching the stimulus episode will be positively correlated with comprehension of both the narrative and educational content.} \]
Narrative Dominance

The first two governing principles of the capacity model tell us that because children watch television with the primary purpose of entertainment, working memory resources are always allocated to processing narrative content before processing educational content (Fisch, 2000). Thus, when the two processes are in competition, priority is given to the processing of the narrative. The result is that the educational content cannot be processed as deeply as it otherwise might be, and therefore, comprehension of the educational content is likely to be impaired. Therefore, it can be argued that comprehension of the educational content is dependent upon a child’s understanding of the narrative.

From the principle of narrative dominance, it follows that children who expend minimal cognitive resources processing the narrative will have a greater amount of resources left over to process the educational content compared to their peers who have a relatively difficult time processing the narrative. Piotrowski (2012) found support for the principle of narrative dominance in her investigation of the influence of story schema skills on preschoolers’ comprehension of educational programming. She found that story schema development led not only to an increase in narrative comprehension, but also to an increase in educational content comprehension. The capacity model explains that viewers have a limited amount of working memory resources available for processing a program as a whole. In this case, for children with well-developed story schema, fewer resources were required to process the narrative, which meant that a greater amount of resources was allocated to processing the educational content. This resulted in greater
comprehension of both the narrative and the educational content.

Because of the influence that narrative processing has on educational content comprehension, it is expected that narrative comprehension will act as a mediating variable. Specifically, it is hypothesized that the viewer characteristics that are positively related to narrative comprehension will also have an indirect effect on educational content comprehension through narrative comprehension. For example, if a viewer scores high in verbal ability, fewer resources would be needed to process the narrative, and, therefore, more resources would be allocated to processing the educational content, resulting in greater comprehension of the educational content. The same is expected to occur with each of the viewer characteristics that have a positive correlation with narrative comprehension. That is, narrative comprehension will act as an intervening variable, mediating the effects of verbal ability, short-term memory, story schema skills, prior knowledge related to the narrative and interest in the narrative on educational content comprehension.

H6: The viewer characteristics that are positively associated with narrative comprehension will have an indirect effect on educational content comprehension through narrative comprehension.

H6a: The relation between verbal ability and educational content comprehension will be mediated by narrative comprehension.

H6b: The relation between short-term memory and educational content comprehension will be mediated by narrative comprehension.

H6c: The relation between story schema skills and educational content comprehension will be mediated by narrative comprehension.
comprehension will be mediated by narrative comprehension.

H6d: The relation between prior knowledge related to the narrative and educational content comprehension will be mediated by narrative comprehension.

H6e: The relation between viewer interest in narrative content and educational content comprehension will be mediated by narrative comprehension.
Methodology

Research Design

This correlational study examined the relations between certain individual differences (i.e., cognitive abilities, interest in the show, and prior knowledge related to the show) and preschoolers’ comprehension of the narrative and educational content of an educational television program within the framework of the capacity model (Fisch, 2000, 2004).

Participants

A total of 83 participants were recruited from 4 preschools/child care facilities in a large Midwestern city. Response rates across the preschools ranged from 24% to 75%. In order to be eligible to participate, the child was required to be between 3 and 5 years of age. This criterion was established for two reasons. First, because narrative comprehension is developmentally associated (Fisch, 2004), it was necessary to constrain the age variation of study participants to help ensure that any measured differences in comprehension were attributable to the experimental manipulation. Second, it was necessary to ensure that the testing items were developmentally appropriate. It was thought that children under the age of three might not have been developmentally prepared to complete narrative comprehension assessments while, conversely, children over the age of five would be likely to demonstrate ceiling effects on a narrative
comprehension assessment.

For recruitment of participants, directors of local preschools and day care centers were contacted and asked if they would be interested in having their school participate. Once school directors agreed to participate, information about the research was distributed to the parents of all eligible children. Of the 83 children whose parents granted consent, three children were unable to participate due to scheduling conflicts, and two children did not want to complete the testing session, resulting in a final sample of 78 children (51.8% male). Participants ranged in age from 38 to 78 months, $M = 52.31$, $SD = 8.1$. Parents who completed the questionnaire (84% mothers) ranged in age from 20 to 49 years. The majority of parents (72%) reported their child’s race as “Caucasian” with 13% identifying their child as “Asian/Pacific Islander,” 9% identifying their child as “multi-racial,” 4% identifying their child as “Black/African American,” and 1% identifying their child as “Hispanic/Latino.” Most of the children in the sample either had no siblings (37%) or had one sibling (51%). The parents in this study were, on average, very highly educated; 60% reported having a graduate degree, 5% had completed some graduate school, 22% had a college degree, 12% completed some college, and 2% had a high school degree or GED. 37% of parents reported a household income of $50,000 to $99,000, 28% reported $100,000 to $149,000, 27% reported over $150,000, and 8.5% reported $25,000 to $49,000. Table 1 contains descriptive statistics of the study population.

**Stimulus**

Distinguishing educational content from narrative content can, at times, be difficult. Especially in the case of prosocial programming, in which children learn about
positive social behavior rather than concrete academic material, it is especially difficult to separate these two types of content. The capacity model is therefore easier to conceptualize in regards to a program in which the narrative content is clearly distinct from the educational content. For this reason, a program with a relatively concrete academic lesson, rather than a prosocial message, was chosen as the stimulus.

The Cat in the Hat Knows a Lot About That! is a television series that, according to the show’s website, is designed to spark a love of learning and an interest in science and math for preschool-aged children (PBS). In each episode, the Cat in the Hat and his six-year-old friends Sally and Nick go on an adventure. Guided by the Cat, the children learn about science by asking questions, making observations, and discussing ideas about how the world works. Each half-hour episode consists of two 11-minute animated adventures, each of which revolves around a specific science concept such as bird migration or animal camouflage. This program was chosen as the stimulus for this study because it a) targets preschool children; b) includes both narrative and educational content; and c) teaches concrete educational content that many preschoolers are likely to be unfamiliar with.

The 11-minute adventure chosen for this study is called “I Love the Nightlife!” In it, the Cat takes Nick and Sally on an all-night adventure, where they meet a variety of nocturnal animals. PBS provides a parents’ site to accompany each of their preschool television programs, where parents can learn about the educational objectives of the show and of each episode. According to that website, the educational objective of this adventure is to teach children that “nocturnal animals – like the owl, the bat, and the
opossum – sleep during the day and hunt for food at night using specialized skills” (PBS).

An informal inquiry of parents with preschool-age children revealed that many children in this age group have not yet learned about nocturnal animals.

**Procedure**

After the consent forms and parent questionnaires had been returned, children were tested individually in a quiet space at their respective schools. First, children completed pre-viewing assessments (verbal ability, short term memory, stimulus familiarity, interest, and prior knowledge). Following the completion of these assessments, each child watched the stimulus episode on a three by five inch portable DVD player. Post-viewing assessments were then administered (story schema, narrative comprehension, and educational content comprehension). Each session ran approximately 30 minutes in length. A parent questionnaire was sent home with each consent form, to be completed by the primary caregiver of each of the participating children. Once consent forms and questionnaires were returned, testing sessions were scheduled at each preschool center. After completing the testing session, each child received two colorful stickers for their cooperation. Each participating preschool center received a few age-appropriate books to be placed in the participating classrooms or a school library.

**Assessments and Measures**

**Parent report measures.** In order to enroll their child for participation in the study, parents had to complete a questionnaire that included background information about the participating child and the family. The information from the questionnaire was
used to describe the study population as well as to check for potential covariates. Appendix A contains copy of the parent questionnaire.

**Demographic variables.** The questionnaire included demographic information such as parent’s education level, household income, race/ethnicity of the participating child, and number of siblings in the household. Table 1 contains descriptive statistics for demographic variables.

**Media use variables.** Parents were also asked about the child’s daily activities in order to assess how much time the child spends interacting with media that might facilitate narrative comprehension, including watching television and reading or being read to. Table 2 contains descriptive statistics for media use variables.

**Television viewing.** The average number of hours that children spend viewing television each day was measured by asking parents to report how often their child watches television during three time periods on an average weekday and on an average weekend. Specifically, parents were asked to think about an average day during the week and to report how many hours their child watches TV during the morning (defined for them as “from the time the child awakens until 12 pm”), the mid-day hours (defined as “between lunch time and dinner time”), and the evening hours (defined as between dinner time and the time your child goes to bed”). They were asked to report the same information for an average day on the weekend.

Two estimates of TV viewing (during the week and the weekend) were calculated by summing across reports of viewing during the three time periods. The sums were then multiplied by either 5 (for the sum during the week) or by 2 (for the sum during the
Average daily television viewing in hours was then calculated by adding the two products together and then dividing by 7 ($M = 1.79, SD = 1.52, Range = 0.14$ to $10.36$).

**Reading.** Because it was thought that time spent reading books might have an effect on children’s story schema development as well as general knowledge, a measure of daily time spent reading or being read to was also included. The average number of hours children spend reading daily was calculated in the same manner as television viewing, with parents asked to estimate “time spent reading or being read to” during three time periods, during the week and on the weekend ($M = 1.29, SD = 0.84, Range = 0.25$ to $4.86$).

**Verbal ability.** The Picture Naming Individual Growth and Development Indicator (Missall & McConnell, 2004) was used as the measure of verbal ability. This expressive vocabulary measure has been shown to be sensitive to children’s growth and development. Picture Naming correlates with other standardized measures of language development and literacy that have traditionally been used in other studies (e.g., Anderson, Field, Collins, Lorch, & Nathan, 1985; Lynch & van den Broek, 2007; Mares & Acosta, 2010; Smith, Anderson, & Fischer, 1985; J. C. Wright et al., 2001), including the Peabody Picture Vocabulary Test (Dunn & Dunn, 1997) ($r = .56$ to $75, p < .001$) and the Preschool Language Scale (Zimmerman, Steiner, & Pond, 1992) ($r = .63$ to $.79, p < .001$). The Picture Naming IGD was chosen over these other scales because of the speed and ease with which the assessment can be administered, as well as the availability of the measure.
To complete the Picture Naming Task, each child was presented with flashcards of color pictures of objects and asked to name as many as they could in one minute. The full set of 120 picture naming cards includes objects found in familiar environments including food, people, household objects, animals, games and sports materials, vehicles, tools, and clothing. Four standard sample cards were used to demonstrate the task and confirm the child’s understanding of the task. Then a randomly selected subset of the deck was used to administer the assessment. The number of pictures named correctly in one minute served as the child’s verbal ability score ($M = 20.49$, $SD = 5.78$, $Range = 6$ to 36).

**Short-term memory.** Alloway, Gathercole, and Pickering (2006) explain that storage processes for short-term memory should be separated into distinct verbal and visuospatial constructs. Therefore, two short-term memory tasks were administered so that each of these constructs could be assessed. Gathercole and Pickering (2001) provide the most widely used battery of working and short-term memory assessments for children (WMTB-C). One verbal short-term memory assessment and one visuospatial short-term memory assessment were selected from this battery based on their test-retest reliability and appropriateness for the age of the participants in this study.

**Digit recall.** The digit recall task was used to assess verbal short-term memory (Pickering & Gathercole, 2001). Of the verbal short term memory tests included in the WMTB-C, digit recall was reported to have the highest test-retest reliability (.84; Alloway, et al., 2006). For this assessment, the researcher would say aloud a sequence of digits and asked the child to recall the digits in the correct order. Each level in this task
consisted of three different sequences, each with the same number of digits. Each child had three chances to correctly recall one of these sequences. If a sequence was recalled correctly, the child moved on to the next level, where an additional digit was added to each sequence. Testing continued until the child failed to recall a sequence or correctly recalled all three sequences at the highest level. In this version of the task, the first level consisted of sequences containing two digits, the second level contained sequences of three digits, and so on until the fourth and final level, which contained 5 digits. Participants received 1 point for every level they successfully completed, resulting in a possible range of 0 to 4 points, \((M = 3.46, SD = 0.66, Range = 2 to 4)\).

**Block recall.** A modification of the block recall task was used to assess visual short-term memory (Pickering & Gathercole, 2001). Compared to other measures in the WMTB-C, reported reliability for the block recall task was .83 (Alloway, et al., 2006). In the original block recall task, the children viewed a video of a series of blocks being tapped, and then were asked to reproduce the sequence in the correct order by tapping on a picture of the blocks. Testing began with a single block tap, and increased by one additional block. Testing continued until the child failed to reproduce a series of taps. This study utilized an adaptation of the original block recall task similar to the procedure used by Archibald and Gathercole (2006). Rather than viewing a video of the block sequences, the researcher tapped out the sequence on a two-dimensional picture of the blocks and then asked the participant to “point to the same blocks, just like I did.” Scores were created similar to the digit recall task, with participants getting three different trials at each level, and scoring one point for every level reached, \((M = 2.22, SD = 1.12, Range = 2 to 4)\).
Digit recall and block recall were summed to create a short-term memory index \( (M = 5.67, SD = 1.54, \text{Range} = 2 \text{ to } 8, \alpha = .60) \).

**Story schema development.** Meadowcroft & Reeves (1989) developed a way to measure children’s story schema skills. This assessment is composed of two tasks that measure two different skills. The sorting task measures the ability to distinguish between central and incidental story content. The sequencing task measures the ability to put events in correct temporal order. Meadowcroft and Reeves (1989) explain that both of these skills are fundamental to the development and use of story schema.

In order to develop the story schema assessment, screen shots were taken from several points in the stimulus episode. Ten adult judges were viewed the episode and rated whether each of the pictures represented central or incidental content, as distinguished by Collins (1978). Pictures that were rated as representing central content by at least 80% of the judges were eligible for inclusion. For the final assessment, the researcher chose six of the eligible pictures that represented various points in the story. From these six selected images, judges were then asked to pick out the three images that represented the most important things that happened in the story. The three highest rated images were used for scoring the sorting task.

Immediately after viewing the stimulus episode, participants completed the sequencing task. The researcher presented each child with the six pictures in a predetermined random order. The researcher then asked the child to put the pictures in the order in which they happened in the story. If necessary, the researcher guided the child by saying, “Which one happened first?” and then “Which one happened next?” until
all six cards were placed. The child was informed that he/she could always change her mind and move the pictures around. To create the sequencing score, one point was awarded for each picture that was in the absolute correct place, and one point was awarded for any two pictures placed in the correct adjacent order, regardless of their relative position ($M = 6.47, SD = 3.93, Range = 0 to 11$).

Then, in the sorting task, children were asked to “point to the picture that shows the most important thing that happened in the story,” then the “next most important thing that happened,” and so on until three pictures were selected. This task was scored by awarding one point for each image that was also ranked as most important by the adult judges ($M = 1.89, SD = 0.83, Range = 0 to 3$). Sequencing and sorting scores were summed to create an index of story schema skills ($M = 8.36, SD = 4.22, Range = 0 to 14, \alpha = .73$)

**Prior knowledge of program content.** This assessment consisted of open-ended questions that were developed to reflect the important themes, related to both narrative and educational content, of the episode. Identified themes include: sleepover party, the Cat finding his hat, using our different senses to find things in the dark, nocturnal animals, and animals using specialized skills to find food. These themes are representative of the “episode overview” and “educational objective” provided on the show’s accompanying parents’ site (PBS). For analysis, this assessment was separated into two subscales: a measure of prior knowledge related to the narrative content (3 items, e.g., “What kinds of things do people do at a sleepover party?”) and a measure of prior knowledge related to the educational content (4 items, e.g., “Can you name any
nocturnal animals?”). Each open-ended response was awarded up to two points. Fully correct answers received 2 points, answers that were feasible responses but not completely accurate received 1 point, and no answer or answers that were irrelevant or unfeasible received 0 points. The 3 items designed to assess prior knowledge about the narrative were summed to create an index ($M = 3.76$, $SD = 1.45$, $Range = 0$ to 6, $\alpha = .35$). The four items designed to assess prior knowledge related to the educational content were summed to create an index ($M = 2.01$, $SD = 2.17$, $Range = 0$ to 8, $\alpha = .65$).

**Interest.** Interest is the variable in this study that has received the least empirical attention. Ainley, Hidi, and Berndorff (2002) provide one of the few operationalizations of interest. They measured $8^{th}$ and $9^{th}$ grade children’s interest in various topics by asking participants to complete a 5-point Likert scale rating “how interesting” they expect a topic to be. Given the age of participants in the current study, this operationalization seems problematic. It is likely that preschool children do not have a solid understanding of the word “interesting.” Thus, it was necessary to develop a new measure. Because of the nature of this study, it was necessary to develop a measure that would capture interest in the narrative content, interest in the educational content, and interest in the program overall. Three subscales were developed.

*Interest in narrative content.* Interest in the story content was operationalized as the participants’ willingness to engage in the types of activities portrayed in the narrative (e.g., “How much would you like to have a sleepover party?”). This measure consisted of three questions with a 4-point Likert response scale. Response options included “not at all” (coded as 0), “a little” (coded as 1), “a lot” (coded as 2), and “a whole lot” (coded as
3) with corresponding hand gestures to aid in the children’s understanding. The three questions were summed to create an index of interest in the narrative ($M = 5.28$, $SD = 2.81$, $Range = 0$ to $9$, $\alpha = .57$).

*Interest in educational content.* Interest in the educational content was operationalized as the participants’ interest in learning about the different types of educational content portrayed in the episode (e.g., “How much would you like to learn about how we use our senses, like seeing, hearing, and smelling?”). Like interest in the narrative, this measure consisted of three questions with a 4-point Likert response scale ranging from “not at all” (coded as 0) to “a whole lot” (coded as 3) with corresponding hand gestures. The three questions were summed to create an index of interest in the educational content ($M = 5.67$, $SD = 3.11$, $Range = 0$ to $9$, $\alpha = .78$).

*Interest in watching the episode.* Interest in watching the episode (hereafter referred to as “interest in viewing”) was operationalized as the participants’ interest in watching a television program about the different themes present in the stimulus episode (e.g., “How much would you like to watch a TV show about animals who stay up all night?”). Like the previous two subscales of interest, this measure consisted of three questions with a 4-point Likert response scale ranging from “not at all” (coded as 0) to “a whole lot” (coded as 3) with corresponding hand gestures. Responses to the three questions were summed to create an index of interest in viewing ($M = 6.47$, $SD = 2.79$, $Range = 0$ to $9$, $\alpha = .78$).

*Narrative comprehension.* A narrative comprehension assessment was created to evaluate how much central content (i.e., that which is central to the plot) participants
were able to understand and recall. In order to develop an initial list of questions, the researcher viewed the episode and drafted as many items as possible corresponding to plot events throughout the episode. Similar to procedures developed by Collins (1978), ten adult judges viewed the program episode and were asked to rate whether they felt the questions assessed central, incidental, or inferential content. Questions that were rated as central content with a minimum agreement of 80% across judges were eligible for inclusion. An effort was made to ensure that questions were representative of the entirety of the episode. The final assessment consisted of 10 questions in total, such as, “Which animal did Nick, Sally, and the Cat hear with their special bat ears?” See Appendix X for a complete list of questions.

For each question, the child was provided with three pictorial response options. Comparative to verbal response options, pictorial response options have been shown superior when working with young children (Linebarger & Piotrowski, 2006). Several episodes of The Cat in the Hat Knows A Lot About That were digitally captured to create screen shots of episode scenes. These screen shots were edited to create stylistically equivalent pictorial response options. Correct answers received 1 point, and incorrect answers received 0 points. A composite score was created by summing responses to the ten questions. Higher composite scores reflected greater comprehension of the narrative ($M = 7.71$, $SD = 1.59$, Range = 2 to 10).

**Educational content comprehension.** An educational comprehension assessment was created to evaluate how much of the educational content presented in the episode participants were able to learn and recall. The website of The Cat in the Hat Knows a lot
About That! describes the “educational objectives” of the series and of each episode (PBS). Using these objectives as a guide, several multiple-choice and open-ended questions assessing the educational content of the episode were developed. Questions were pretested by asking ten adult judges to rate whether or not the information could be ascertained from the episode. Questions with at least 80% agreement were eligible for inclusion. The final assessment consisted of five multiple choice questions, e.g., “Who is the best at seeing in the dark – humans, owls, or bats?” and five open-ended questions, e.g., “What does nocturnal mean?”

For multiple-choice questions, pictorial response options were provided. Correct answers received 1 point, and incorrect answers received 0 points. For open-ended questions, children were provided with an orienting image and asked to provide their own verbal response. For all open-ended questions, partial credit was awarded. Fully correct answers received 2 points, answers that were feasible responses but not completely accurate received 1 point, and no answer or answers that were irrelevant or unfeasible received 0 points. A composite score was created by summing responses to the ten questions. Higher composite scores reflected greater comprehension of the educational content, ($M = 7.63$, $SD = 4.19$, $Range = 0$ to 15).
<table>
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<th>Variable</th>
<th>Mean (SD)</th>
<th>Frequency</th>
<th>Percent</th>
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<td></td>
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<tr>
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<td>Parent’s relationship to child</td>
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Table 1. Demographic Variables
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<th>Max.</th>
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<th>Frequency</th>
<th>Percent</th>
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Table 2. Media Use Variables
Results

This study looked at the relations between certain individual differences in children and their comprehension of an educational television program, as proposed in Fisch’s capacity model (2000, 2004). Multiple regression analyses were planned for each of the hypotheses. All analyses were done using SPSS version 19. Prior to the outcome-based analyses, analyses related to covariate inclusion were completed. Potential covariates were identified by examining the demographic and media use information that was collected in the parent questionnaire. Bivariate relationships among each of the potential covariates and the independent and dependent variables were examined using Pearson correlations. The following four control variables were found to be significantly associated with at least one of the outcome variables and thus were included in the subsequent regression models: child’s age, child’s sex, parent’s education level, and household income. Table 3 presents the correlations between the control variables, independent variables, and dependent variables.

For each multiple regression analysis, the four control variables were entered into the first block of the equation, and the independent variable addressed in the hypothesis was entered into the second block of the equation. The block of control variables accounted for 21% of the variance in narrative content comprehension and 35% of the
variance in educational content comprehension. Table 4 summarizes the results of the regression analyses.

The first multiple regression analysis examined the relation between children’s verbal ability and their comprehension of the narrative (H1). Although verbal ability and narrative comprehension were found to be positively correlated ($r(79) = .326, p < .005$), after entering controls into the regression model, verbal ability was not found to be a significant predictor of narrative comprehension ($\beta = .13, p = .32$). Examination revealed that the effect of the child’s age on narrative comprehension eradicated the effect of verbal ability. Thus, H1 was not supported.

To address H2, a multiple regression analysis was conducted to examine the relation between children’s short-term memory and their comprehension of the narrative content. A significant relation was found such that children who scored higher in short-term memory performed better in narrative content comprehension ($\beta = .29, p < .05$). Short-term memory was found to explain an additional 4.7% of the variance in narrative content comprehension ($p < .05$). This provided support for H2.

To address H3, a multiple regression analysis was conducted to examine the relationship between children’s story schema development and their comprehension of the narrative. The composite story schema score was not found to be significantly related to narrative comprehension ($\beta = .19, p = .16$). However, because the two components of story schema development included in this measure tapped into very different skill sets (i.e., sorting based on importance vs. sequential ordering), it was thought that the two components might have different effects on narrative comprehension. Therefore, in a
post-hoc analysis, this hypothesis was investigated further by entering the scores on the two components of the task into the second step of two separate regression models. Although the sequencing score was not found to be a significant predictor of narrative comprehension ($\beta = .14, p = .30$), the sorting score was found to be significant such that those who scored higher on the sorting task tended to perform better on narrative comprehension ($\beta = .22, p < .05$). A significant 4% of the variance in narrative comprehension was explained by sorting ability ($p < .05$). Thus, H3 was partially supported.

To address H4, two multiple regression analyses were conducted. The first model looked at the relation between prior knowledge related to the narrative and narrative comprehension (H4a). Prior knowledge related to the narrative was found to be a significant predictor of narrative comprehension such that children who scored higher in prior knowledge tended to score higher in narrative comprehension ($\beta = .24, p < .05$). A significant 4% of the variance in narrative content comprehension was explained by this variable ($p < .05$). The second model looked at the effect of prior knowledge related to the educational content on educational content comprehension (H4b). Again, a significant positive relationship was found such that children who scored higher in prior knowledge about educational content tended to score higher in educational content comprehension ($\beta = .43, p < .005$). This variable explained an additional 14.8% of the variance in educational content comprehension ($p < .005$). Thus, H4a and H4b were supported.

To address the components of H5, four multiple regression analyses were conducted. The first model tested the relation between interest in the narrative and
narrative comprehension (H5a). No significant relationship was found ($\beta = -0.11, p = .32$).

The second model tested the relation between interest in the educational content and educational content comprehension (H5b). Again, no significant relationship was found ($\beta = -0.11, p = .25$). The next two models were used to investigate the relation that interest in viewing the episode had with both narrative and educational content comprehension (H5c). No significant relationships were found (narrative comprehension: $\beta = -0.15, p = .15$; educational content comprehension: $\beta = -0.06, p = .49$), and thus, H5 was not supported.

H6 was designed to test the principle of narrative dominance, the idea that priority is given to processing narrative content over processing educational content. To address each sub-hypothesis, a mediation analysis was conducted using PROCESS for SPSS. PROCESS generates the direct and indirect effects of some predictor ‘X’ on some outcome ‘Y’ along with the linear models used to estimate these effects. Coefficients of the model are estimated using OLS regression. This bootstrapping method is recommended for small sample sizes because it does not assume a normal distribution, and has been shown to have greater statistical power compared to the causal steps approach to testing intervening variables (A. F. Hayes, 2009). It also allows for the testing of an indirect effect in the absence of a direct association between the predictor and outcome variables, which was appropriate for the current study given that the predictor variables were not expected to have a direct effect on the outcome variable. PROCESS measures significance using point estimates as well as 95% bootstrap confidence intervals for the indirect effects using 10,000 bootstrap samples. A significant
indirect effect with a significant direct effect indicates partial mediation, while a significant indirect effect with no significant direct effect indicates full mediation. Table 5 summarizes the results of the mediation analyses.

H6a predicted that narrative comprehension would mediate the relation between verbal ability and educational content comprehension. Since no significant relation was found between verbal ability and narrative comprehension (H1), the possibility of a mediation effect was eliminated. Thus, H6a was not tested.

H6b predicted that narrative comprehension would mediate the relation between short-term memory and educational content comprehension. The indirect effect of short-term memory on educational content comprehension through narrative comprehension was significant, $\beta = 0.16$, 95% CI (0.01, 0.49), 1000 bootstrap samples. Although not predicted in the hypothesis, the analysis also revealed a significant direct effect of short-term memory on educational content comprehension, indicating partial mediation through narrative comprehension, $\beta = 1.10$, 95% CI (0.48, 1.72), 1000 bootstrap samples. Taken together, the direct and indirect effects indicate that those participants who scored relatively high in short-term memory, showed better comprehension of the narrative, which in turn resulted in greater comprehension of the educational content, supporting H6b.

H6c predicted that narrative comprehension would mediate the relation between story schema development and educational content comprehension. In H3, it was found that scores on the sorting task, but not on the sequencing task nor on story schema overall, were significantly related to narrative comprehension. Therefore, sorting scores
rather than composite story schema scores were entered into the model. The indirect
effect of sorting ability on educational content comprehension through narrative
comprehension was significant, $\beta = 0.25$, 95% CI (0.02, 0.69), 1000 bootstrap samples.
Again, although not predicted in the hypothesis, analysis also revealed a significant direct
effect of sorting ability on educational content comprehension, indicating partial
mediation through narrative comprehension, $\beta = 1.32$, 95% CI 0.35, 2.29), 1000
bootstrap samples. This indicates that those who scored relatively high in sorting ability
showed better comprehension of the narrative, which in turn resulted in greater
comprehension of the educational content, partially supporting H6c.

H6d predicted that narrative comprehension would mediate the relation between
interest in the narrative and educational content comprehension. No significant relation
was found between interest and narration comprehension (H5), ruling out the possibility
of a mediation effect, and so H6d was not tested.

H6e predicted that narrative comprehension would mediate the relation between
prior knowledge related to the narrative and educational content comprehension. The
indirect effect of prior knowledge related to the narrative on educational content
comprehension through narrative comprehension was significant, $\beta = 0.16$, 95% CI (0.01,
0.46), 1000 bootstrap samples. The direct effect was not significant, indicating complete
mediation, $\beta = 0.46$, 95% CI (-0.16, 1.08), 1000 bootstrap samples. This result indicates
that narrative comprehension was the mechanism through which prior knowledge related
to the narrative influenced educational content comprehension, supporting H6e. For those
participants who scored relatively high in prior knowledge related to the narrative,
narrative comprehension was increased, which in turn increased educational content comprehension.
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*p < .05, **p < .01, ***p < .001

Table 3. Pearson Correlations between Variables
### Dependent Variable: Narrative Comprehension

Control Variables (Block 1) | B  | SE  | β   | $R^2$ change
---|-----|-----|-----|-------------------
Child’s age                | .08**| .02 | .41**|
Child’s sex                | -.43 | .32 | -.14 |
Parent’s education         | .06  | .15 | .04  |
Household income           | -.09 | .15 | -.06 |
Total                       |      |     |      | .21**          

Independent Variables (Block 2, entered separately)

Verbal ability             | .04  | .04 | .13  | .01  |
Short-term memory          | .30* | .14 | .29* | .05* |
Story schema composite     | .07  | .05 | .19  | .02  |
Sorting                    | .42* | .21 | .22* | .04* |
Sequencing                 | .06  | .06 | .14  | .01  |
Prior knowledge related to the narrative | .27* | .13 | .24* | .04* |
Interest in the narrative  | -.06 | .06 | -.11 | .01  |
Interest in viewing        | -.09 | .06 | -.15 | .02  |

### Dependent Variable: Educational Content Comprehension

Control Variables (Block 1) | B   | SE  | β   | $R^2$ change
---|-----|-----|-----|-------------------
Child’s age                | .29**| .05 | .55**|
Child’s sex                | -.45 | .77 | -.06 |
Parent’s education         | -.51 | .35 | -.15 |
Household income           | .46  | .36 | .13  |
Total                       |      |     |      | .35**          

Independent Variables (Block 2, entered separately)

Prior knowledge related to the educational content | .83** | .28 | .43** | .15** |
Interest in the educational content            | -.15  | .13 | -.11  | .01  |
Interest in viewing                             | -.10  | .14 | -.07  | .00  |

* $p < .05$, **$p < .001$

Table 4. Results of Regression Analyses
Indirect Effect | Direct Effect
--- | ---
Variable | β | 95% CI | β | 95% CI
--- | --- | --- | --- | ---
Short-term memory | .16* | [.01, .49] | 1.10* | [.48, 1.72]
Sorting ability | .25* | [.02, .69] | 1.32* | [.35, 2.29]
Prior knowledge related to educational content | .16* | [.01, .46] | .46 | [-.16, 1.08]

Dependent variable: Educational content comprehension
Intervening variable: Narrative comprehension
* p < .05

Table 5. Results of Mediation Analyses
Discussion

Fisch’s capacity model is a theoretical model designed to explain how children learn from educational television (Fisch, 2000, 2004). Specifically, the model focuses on the allocation of cognitive resources to two parallel processes: narrative comprehension and educational content comprehension. While much research has focused on the characteristics of television programs that impact attention and comprehension, less attention has been paid to the individual differences in children that can impact the viewing experience. The goal of this study was to investigate the role of the viewer characteristics described in the capacity model in preschoolers’ comprehension of an educational television program.

The data presented here appear to provide some support for the predictions of the capacity model. Short-term memory, sorting ability (part of story schema development), and prior knowledge regarding the narrative were all found to be positively associated with narrative content comprehension. These variables were also found to have an indirect effect on educational content comprehension through narrative comprehension, supporting the principle of narrative dominance. Additionally, prior knowledge related to the educational content was found to be positively associated with educational content comprehension. Verbal ability was not found to have an effect on narrative comprehension, and the three components of interest (i.e., interest in the narrative,
interest in the educational content, and interest in viewing the program) were not found to be significantly related to either narrative comprehension or educational content comprehension.

One of the questions addressed in this study was whether or not program-specific viewer characteristics would have an impact on comprehension in addition to the more widely studied cognitive abilities. The results pertaining to prior knowledge did support the proposed importance of program-specific viewer characteristics. Prior knowledge related to the narrative and prior knowledge related to the educational content were found to be significant predictors of narrative comprehension and educational content comprehension, respectively. This finding aligns closely with research done in the domain of scripts and schema, in which children were found to better learn new information when it aligned closely with previously learned material, family background, or commonly held stereotypes (Adams & Worden, 1986; Collins & Wellman, 1982; Spilich, Vesonder, Chiesi, & Voss, 1979). It seems that an existing knowledge structure related to the television program facilitates learning by providing children with a mental representation on which to map the new information. Rather than learning totally foreign and novel concepts, which might require repeated exposure, children who had some prior knowledge related to the program were able to retain the concepts and information, even in a one-time exposure situation, because they had a pre-existing mental structure for storing such information.

However, the results pertaining to interest did not add support for the importance of viewer-specific characteristics. Neither interest in the narrative, interest in the
educational content, nor interest in viewing the episode were significantly related to comprehension. There are two possible conclusions that can be drawn from these data. First, the lack of significant findings could stem from a host of potential measurement problems. It is difficult to compare the operationalization of interest here to prior studies of interest because the concept has rarely been operationalized. Ainley, Hidi, and Berndorff (2002) found links between interest and learning in the domain of formal education, but few, if any, studies to date that have looked at the concept in a mediated, informal learning situation, particularly not with preschool-age children. Given the lack of prior research on the topic, we can really only speculate on what the measurement problems may have been. Response options for each question regarding interest in this study ranged from “not at all” (0) to “a whole lot” (4). It may be that for children of this age group, a four-point scale was too complex. For example, it might have been difficult for children to grasp the difference between “a lot” and “a whole lot.” This was supported by anecdotal evidence from the data collection. In several instances, children responded with some variation or combination of the response options, such as “a little lot.” In these instances, the researcher repeated the options in an attempt to clarify, but still, this indicates that the children may not have correctly understood the meaning each option or the relations between options. Future research should include different wording of response options and investigate whether the use of more or less response options would be helpful. It would also be worthwhile to investigate the use of pictorial cues for response options. In this study, hand gestures were used to accompany each response
option, but pictures might have provided a more concrete visual aid for the children and would have been more reliable across testing sessions.

Second, it could be that interest is simply not a meaningful concept when it comes to children and television. Young children have a very goal driven, object-centered conception of the world (Siegler & Alibali, 2005). The idea of interest as a hypothetical desire to partake in some activity may therefore be beyond the scope of what young children can mentally grasp. Furthermore, although not statistically significant, the coefficients of the interest variables indicated that they were negatively related to comprehension in all three instances (i.e., children who reported less interest tended to perform better on comprehension assessments). This indicates that interest may have had the opposite effect of what was intended. Perhaps children who were overly excited reported higher interest due to a positivity bias, but were then so excitable during the viewing that they did not fully attend to the program, resulting in poor comprehension. One consumer research study found that arousal while watching a televised sporting event negatively affected recognition of embedded sponsorship material (Pham, 1992). Although the domain of that study was quite different from an educational context, the results do suggest that arousal can have a negative impact on attention to details of a televised program. Future research should seek to disentangle these possible explanations by coming up with alternative operationalizations of interest and testing them within the framework of the capacity model.

The cognitive abilities addressed in the study also had mixed results. Short-term memory was found to be a significant predictor of narrative comprehension, supporting
one of the tenets of the capacity model. The data suggest that children who had a greater
capacity for short-term memory function performed better than their peers in the narrative
comprehension assessment. This finding aligns with the work of Jacobvitz et al., (1991),
who found that short-term memory skills were a strong predictor of children’s
comprehension of a television program. They posited that children with well-developed
short-term memory skills were able to allocate fewer resources to recalling the story
events, and, therefore, were able to allocate more working memory resources to higher-
level comprehension. This explanation fits very well within the theoretical framework of
the capacity model, which states that the efficient use of resources in working memory
lessens the demands of processing the narrative. Beyond the mediated context, studies in
developmental psychology have also shown that short-term memory skills are predictive
of performance in English and math. Gathercole (2004) argued that the cognitive
processes required for learning are constrained by the general capacity of working
memory. This study utilized not only one type of working memory assessment, but rather
assessed both verbal and visuospatial short-term memory, making the short-term memory
variable a comprehensive one.

It was quite surprising to find that verbal ability, as measured by the Picture
Naming Task (Missall & McConnell, 2004), was not a significant predictor of narrative
comprehension. This finding is in direct contrast to the results of previous studies that
have investigated this issue. Eckhardt, Wood, and Jacobvitz (1991) found that verbal
ability was the best predictor of adults’ immediate comprehension of a television
program. Specifically with children, Jacobvitz, Wood, and Albin (1991) found verbal
ability to be a significant predictor of five-year-olds’ comprehension of the central content of a television show. From these findings, Fisch (2000, 2004) predicted that children with better verbal skills would be able to spend fewer resources on processing verbal information, leaving more resources available for processing the narrative. However, it seems that further research is necessary to address whether or not this viewer characteristic should really be included in the model. Results of the current study indicated that it might be age, rather than verbal ability, that has the most direct association with narrative comprehension, at least for children in the preschool age range. Similarly, Gathercole, Willis, Emslie, and Baddeley (1992) found that it was not until age 5 that vocabulary knowledge emerged as a major predictor of other developmental processes. Therefore, it stands to reason that the capacity model may need to clarify whether age or vocabulary ability should be used in the model based on the age of participating children.

Alternatively, there may have been a problem with the measure of verbal ability that was used in the current study. The Picture Naming Task is a very basic measure of expressive vocabulary only. It does not take into account receptive vocabulary skills, which develop earlier than expressive vocabulary skills (Wise, Sevcik, Morris, Lovett, & Wolf, 2007). Because receptive vocabulary assessments tend to be more sensitive than the PNT, it is possible that they might show more variation among children of the same age. Future research should include more sophisticated and extensive assessments of verbal ability (such as the Peabody Picture Vocabulary Task, which is a more traditional measure of verbal ability) to see if there might be, in some instances, an effect of verbal...
ability on narrative comprehension above and beyond what is accounted for by age
differences in preschoolers.

It was also surprising to find that the role of story schema development was only
partially supported in this study. Specifically, sorting of central versus incidental content
was found to be related to narrative comprehension, but sequencing of the story events
was not. It is difficult to speculate on why one component of the measure worked as
predicted but not the other. Meadowcroft and Reeves (1989) explain that both skills (i.e.,
the ability to distinguish between incidental and inferential content and the ability to put
events in correct temporal order) are fundamental to the development and/or use of story
schema. Based on the limited prior research on this particular topic, it seems that there
may have been a problem with how the task was administered for this study.

In one of the few existing tests of the capacity model, Piotrowski (2012) found
support for the role of story schema development (measured as both sequencing and
sorting ability) in narrative processing. The two studies are very comparable in the sense
that they both investigated preschoolers’ learning from an educational television
program, and both operationalized story schema in a similar manner. However, there was
one major difference in the way that story schema skills were assessed in the two studies.
Piotrowski measured story schema development in a separate testing session, with a
television program that was distinct from the stimulus program for the study. In the
current study, due to time limitations for the testing sessions, the story schema
assessment was designed to be administered during the same testing session as the other
assessments by utilizing the stimulus video that the participants were already watching.
Caution was taken to administer the story schema assessment immediately after viewing in order to minimize the possibility of bias from the other assessments. However, it is possible that children were overwhelmed by the multitude of assessments and might have performed better if the story schema assessment was administered separately.

Furthermore, the story schema assessment used in both of these studies was a proxy measure of story schema developed for use with television rather than text, which is used in more traditional measures of story schema. The benefits of this type of measure are that it may tap into skills that are particularly associated with television viewing rather than reading, and it can be administered very quickly and easily. However, since results are not yet consistent, it would be advisable to replicate this part of the study using standardized measures of story schema in addition to this version created for television.

Nevertheless, the data did provide some support for the inclusion of story schema development in the capacity model. Successful completion of the sorting task represents the ability to distinguish central from incidental content. Those who scored relatively high on the sorting task, therefore, were less likely to waste working memory resources attending to the unimportant incidental content, and thus had more resources available for processing the educational content.

Importantly, the concept of narrative dominance, one of the governing principles of the capacity model was supported by these findings. The significant mediation effect suggested that narrative comprehension acted as the mechanism through which several viewer characteristic affected comprehension of the educational content. As predicted by Fisch (2000, 2004), it seems that when fewer resources are necessary for processing the
narrative, more resources can be allocated to processing the educational content, resulting in greater comprehension of the educational material. In this study, short-term memory, story schema skills, and prior knowledge related to the narrative successfully facilitated narrative comprehension in such a way as to produce this effect. These “helpers” of narrative processing allowed a greater proportion of the cognitive resource pool to be allocated to processing of the educational content.

The logic behind the principal of narrative dominance is not limited to the capacity model. The principle aligns closely with other theories of message processing such as the limited capacity model of motivated mediated message processing (LC4MP), which also states that humans have a limited cognitive capacity for processing mediated messages and that we can allocate resources differently depending on the function of the mediated message for the viewer (Lang, 2000). Similarly, in the domain of educational psychology, cognitive load theory is used to inform the instruction of multi-media instructional technologies and is dependent on the idea of limited cognitive capacity. In a study based on cognitive load theory, Mayer and Moreno (2003) found several instances in which users of instructional technology were able to reduce cognitive overload by altering their use of parallel cognitive processes. For example, they explain that visual processing often supersedes audio processing, but that learners can effectively utilize both channels by training the brain to place a greater emphasis on auditory information. Although the specific processes differ, the principle of narrative dominance similarly asserts that preference is given to narrative processing but that certain strategies can be used to alter this allocation of resources.
It is interesting to note that time spent viewing television, and time spent reading or being read to did not emerge as significant covariates to be included in the models. It was thought that these variables might influence children’s processing of the program content. Familiarity with television viewing, especially with certain programs, has been shown to facilitate learning and comprehension (Crawley et al., 2002). It has also been found that that time spent reading can be related to an increase in exposure to stories that conform to the prototypical story structure, which in turn influences story schema development (Mandler & Johnson, 1977). The measures of media use utilized in this have been successfully used in other work (e.g., Nathanson, Sharp, Alade, Rasmussen, & Christy, 2013), and so it seems safe to argue that general TV exposure and reading are not related to comprehension under the framework of the capacity model.

**Implications**

This research has implications in many domains. Practically speaking, these findings can help to inform parents and educators about the most effective ways to incorporate educational television into children’s daily routines. For example, the effect of prior knowledge on comprehension suggests that educational television shows might be useful in supplementing in-school learning when the relevant concepts are reflected in the show. If a child views a television show that focuses on content similar to what is being taught in school, the child will be more likely to learn and retain the information.

Support for the principle of narrative dominance is an important finding for television producers to keep in mind. These results indicate that no matter how well developed the educational content of a show is, children will not be able to process and
learn that content if they are not able to easily process the narrative. Therefore, efforts
should be made to ensure that the narrative of a program is clearly and easily understood
by young children, or else it is unlikely that even the most well designed educational
content will be processed.

Speaking more broadly, this research also has important theoretical implications
as it provides support for Fisch’s capacity model as a framework for understanding how
children learn from educational television. There are few theories available to explain
how young children process media, and much of what does exist focuses on negative
reactions and consequences. It is important to have a theoretical model for looking at the
positive effects of media, since it is widely accepted that these benefits do exist

Limitations and Conclusion

There were several limitations to the current study. First, it should be noted that
there is an inherent limitation of using only one stimulus program rather than a variety of
television shows as stimuli. The effects of this study may be specific to the program, and
thus, not be generalizable to educational television in general. The program used as the
stimulus in this study airs on PBS, a network that is known for creating high-quality
educational programming. Each episode of The Cat in the Hat Knows A Lot About That!
dergoes a fairly extensive process of consulting with children’s media experts during
the writing and storyboarding production stages. Therefore, the show is particularly likely
to conform to the expectations of the capacity model. Future studies should be conducted
with more stimuli and more conditions to further explore and test the predictions of the
capacity model to see if it holds as a reliable framework for a generalizable sample of children’s television programs.

The participants in this study represented a convenience sample, and thus, it is unknown whether or not these findings are generalizable to preschool audiences at large. Furthermore, the sample as a whole represented families with relatively high socioeconomic status (SES). Studies have shown that children in low SES families are affected by media differently than their peers in high SES families. For example Linebarger and Piotrowski (2009) found that televised narratives had a particularly beneficial impact on “at-risk” preschoolers. The potential benefit of educational television is less when children are already performing at advanced levels. Because the children in this study came from high SES families, it is likely that they were already outperforming their low SES peers in academic performance, and thus, there was less room for improvement from educational television. Future research should test the capacity model in a more economically diverse, nationally representative sample in order to see if the tenets of the capacity model are applicable to all children.

One viewer characteristic proposed in the capacity model that was not addressed in this study is knowledge of the formal features of television. Fisch (2000, 2004) predicted that knowledge about the conventions of the television would aid in comprehension, but testing this prediction was beyond the means of the current study. Future tests of the capacity model should include this prediction.

Although this study investigated more tenets of the capacity model than had been attempted previously, one major component of the model was not addressed. According
to the model, there are three things that affect the allocation of working memory resources when children watch educational television: 1) processing of the narrative, 2) processing of educational content, and 3) the distance between the educational content and the narrative. When distance between the narrative and educational content is low, processing of these two types of content occurs in tandem. When distance is high, processing of the narrative and processing of the educational content compete with each other, vying for the same working memory resources. The stimulus program used in this study had a relatively low distance between the narrative and educational content, i.e., the educational lesson was well embedded into the story. It would be useful to understand how the viewer characteristics investigated in this study might function differently in various distance situations. For example, in a high distance situation, we might see greater evidence of the mediating effect of narrative comprehension. The principle of narrative dominance tells us that preference would be given to narrative processing, resulting in fewer resources left over for processing of the educational content. From the principles of the model, it follows that mastery of the educational content is virtually impossible in high distance situations. Using several stimuli with varying degrees of distance would be a good way to test this assertion.

The capacity model serves as an important first step in theorizing about children’s learning from educational television, but it seems that more research is needed to fully understand the viewer characteristics that are important to the model. Importantly, the capacity model does not account for the direct effects of short-term memory, story schema skills, and prior knowledge related to the narrative on educational content.
comprehension that were found in this study. Perhaps the inclusion of and elaboration on the mediation effects observed in this study would create a clearer picture of the underlying mechanisms at work in children’s processing of educational television. Overall, this study provides encouraging support for the continued study of the educational potential of well-made, age appropriate television for children.
References


Appendix A: Parent Questionnaire
Thank you for your participation! Please return this questionnaire along with the two consent forms to your child’s teacher in a sealed envelope by MONDAY, FEBRUARY 11, 2013.

Instructions: Please record an answer for each question. There are no right or wrong answers. It is important that participants provide honest and accurate information so that we can best understand the role of media in preschoolers’ lives. Remember that your answers will be kept completely anonymous.

In the following section, please report the media habits of the child who is participating in this study. Please think about only this child when answering these questions.

1. On average, how many days of the week does your child watch TV programs? This can include programs seen on a television, computer, or via DVD or a portable electronic device.
   - 0 days
   - 1 day
   - 2 days
   - 3 days
   - 4 days
   - 5 days
   - 6 days
   - 7 days

2. Think about a typical day during the week (Monday through Friday). About how many hours does your child watch TV during each of the following time periods:
   - Morning (from the time the child awakens until 12 pm)
   - Afternoon (between lunch and dinner time)
   - Evening (between dinner and bedtime)

3. Think about a typical day during the weekend (Saturday and Sunday). About how many hours does your child watch TV during each of the following time periods:
   - Morning (from the time the child awakens until 12 pm)
   - Afternoon (between lunch and dinner time)
   - Evening (between dinner and bedtime)

4. On average, how many days of the week does your child read books or have books read to him/her?
   - 0 days
   - 1 day
   - 2 days
   - 3 days
   - 4 days
   - 5 days
   - 6 days
   - 7 days

5. Think about a typical day during the week (Monday through Friday). About how many hours does your child spend reading or being read to during each of the following time periods:
   - Morning (from the time the child awakens until 12 pm)
   - Afternoon (between lunch and dinner time)
   - Evening (between dinner and bedtime)

6. Think about a typical day during the weekend (Saturday and Sunday). About how many hours does your child spend reading or being read to during each of the following time periods:
   - Morning (from the time the child awakens until 12 pm)
   - Afternoon (between lunch and dinner time)
7. On average, how many days of the week does your child play video games or computer games (including games on a smart phone, iPad, or tablet)?

- 0 days
- 1 day
- 2 days
- 3 days
- 4 days
- 5 days
- 6 days
- 7 days

8. Think about a typical day during the week (Monday through Friday). About how many hours does your child play video games or computer games (including games on a smart phone, iPad, or tablet) during each of the following time periods?

   Morning (from the time the child awakens until 12 pm) _______
   Afternoon (between lunch and dinner time) _______
   Evening (between dinner and bedtime) _______

9. Think about a typical day during the weekend (Saturday and Sunday). About how many hours does your child play video games or computer games (including games on a smart phone, iPad, or tablet) during each of the following time periods?

   Morning (from the time the child awakens until 12 pm) _______
   Afternoon (between lunch and dinner time) _______
   Evening (between dinner and bedtime) _______

10. Does your child have a TV in his/her bedroom?
    - Yes
    - No

11. At what age did your child first begin to watch TV? _______

12. What are your child’s favorite TV programs? (you can list up to 3)

    __________________________________________________________
    __________________________________________________________
    __________________________________________________________
13. How often does your child watch the following television programs? (Please circle your answer.)

The Cat in the Hat Knows A Lot About That!

<table>
<thead>
<tr>
<th></th>
<th>Never</th>
<th>1-2 times a week</th>
<th>3-5 times a week</th>
<th>More than 5 times a week</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sid the Science Kid</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Never</td>
<td></td>
<td></td>
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<tr>
<td>Super Why!</td>
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<tr>
<td>Never</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dora the Explorer</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Never</td>
<td></td>
<td></td>
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<td></td>
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<tr>
<td>Bubble Guppies</td>
<td></td>
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<td>Never</td>
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<tr>
<td>Team Umizoomi</td>
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<td></td>
</tr>
<tr>
<td>Never</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
DEMOGRAPHIC INFORMATION

16. Please list age of the child participating in the study? ______

17. What is the date of birth of the child participating in this study? _____/_____/_____

18. What is the sex of the child participating in this study?
   □ Male
   □ Female

19. How would you describe your child’s race/ethnicity? (choose all that apply)
   □ Black/African American
   □ Hispanic
   □ White/Caucasian
   □ Asian or Pacific Islander
   □ Native American
   □ Multi- racial

20. How many siblings does this child have that are currently living in the same household? ______

21. Please list the ages of siblings living in the same household ______________________

22. What is your relationship to the child who is participating in the study?
   □ Mother
   □ Father
   □ Other ______________________

23. What is your current marital status?
   □ Never married / Single
   □ Married
   □ Living as married
   □ Divorced
   □ Separated
   □ Widowed

24. Please indicate your current age: ______

25. How much education have you had?
   □ Less than high school
   □ High school or GED
   □ Some college
   □ College degree
   □ Some graduate school
   □ Graduate degree

26. Please report your annual household income.
   □ Less than $10,000
   □ $10,000 to $14,999
   □ $15,000 to $24,999
   □ $25,000 to $49,999
   □ $50,000 to $59,999
   □ $60,000 to $149,999
   □ $150,000 to $199,999
   □ $200,000 or more

Thank you for your participation! Please return this questionnaire along with the two consent forms to your child’s teacher in a sealed envelope by MONDAY, FEBRUARY 11, 2013.
Appendix B: Recording Form
Preschoolers' Learning from Educational TV Recording Form

<table>
<thead>
<tr>
<th>Child's Name</th>
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</thead>
<tbody>
<tr>
<td>Gender of Child</td>
</tr>
<tr>
<td>School Name</td>
</tr>
<tr>
<td>Date</td>
</tr>
<tr>
<td>Data Collector Name</td>
</tr>
</tbody>
</table>

Notes

Materials Needed:
- [ ] Picture Naming Test Cards
- [ ] Timer
- [ ] Assessment Binder
- [ ] DVD player
- [ ] “Nightlife” DVD
- [ ] Stickers

START HERE

Intro: Hi! My name is ______, and I work at OSU. My job is to find out what kids like you think. You can help me today by playing some games with me and answering some questions. We will also watch a short video. I think you’ll like all of these activities, but if you want to stop at any time, you just tell me, and we’ll stop – no problem. Are you ready to get started?
Picture Naming Task

*First, we’re going to play a game using these picture cards.*

**Remember**
- Follow directions below exactly as written, reading aloud all words in **bold**.
- Continue to Picture Naming Test Administration, only if the child names all four sample cards correctly during this Sample Administration.

**Sample Items Administration Procedure**
1. Select the four practice items from the stack: apple, baby, bear, cat.
2. Say, "I'm going to look at these cards and name what's in the picture. Watch what I do."
3. Look at and clearly name the four sample cards while the child observes.
4. Say, "Now you name these pictures."
5. Show the four sample cards to the child in the same order as you named them, and give the child an opportunity to name each picture.
6. Praise the child for naming the picture correctly; otherwise, provide the correct picture name. If the child responds in a different language, say "This is also called a (picture name). Call it a (picture name)."
7. Continue on to Test Administration only if the child names all four pictures correctly. **Select NA on this recording form if you don’t continue administration.**

**Test Items Administration Procedure**
1. Shuffle stimulus cards (NOT practice items, though) before starting.
2. Say: "Now we're going to look at some other pictures. This time, name them as fast as you can!"
3. Start the stopwatch and immediately show the first card to the child.
4. If the child does not respond within 3 seconds, point to the picture and say: "Do you know what that is?" or "What's that?" If the child still does not respond within an additional 2 seconds, show the next card.
5. As soon as the child names a picture, show the next card.
6. **After 1 minute, STOP showing cards to the child.** Record the total number of correctly named and incorrectly named pictures on the recording form (do not include correct responses from sample items).

---

**PNT Test Not Applicable (check here):**

**PN_1. PNT SCORE - Number Correct:**

**PN_2. PNT SCORE - Number Incorrect:**
Digit Recall Task
Next we're going to play a game with numbers. Whatever I say, you repeat the same thing back to me, okay?

Let's practice. If I say "1, 2" you say...
[Make sure child says "1.2" and understands the activity before moving on.]

Great job! Let's try some more, just like that.
[As soon as child repeats a sequence correctly, move onto the next block. After 3 consecutive failed attempts within a single block, the task is terminated.]
Block Recall Task
Great job! You are so smart! For the next game, we’re going to look at this picture of different colored blocks. Whichever blocks I point to, I want you to use your finger and point to the same blocks, just like I do.

Let’s practice!
First I go [point to purple block, then blue block] Now you repeat what I did.

[Make sure child points to same blocks in same order and understands the activity before moving on.]

Awesome! Let’s do some more just like that.

☐ Green...Red
☐ Yellow...Dark Grey
☐ Dark Blue...Brown

☐ Yellow...Light Blue...Dark Grey
☐ Dark Blue...Purple...Brown
☐ Dark Grey...Red...Yellow

☐ Purple...Brown...Green...Dark Grey
☐ Dark Blue...Yellow...Red...Light Grey
☐ Red...Dark Grey...Brown...Light Blue

☐ Green...Brown...Light Blue...Yellow...Purple
☐ Dark Blue...Dark Grey...Red...Purple...Light Blue
☐ Yellow...Light Blue...Green...Dark Blue...Red
Prior Knowledge Assessment
Now I have some questions to ask you. Remember there are no right or wrong answers. I just want to hear what you think.
[If child does not respond, probe: Can you think of anything?]
[If child give single response, probe up to 2 times: Anything else?]

1. What do people do at a sleepover party?

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

2. What does the Cat in the Hat usually wear on his head?

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

3. Is it easy or difficult to find something in the dark? Why?

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

4. What senses can we use to help us find things?

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

5. What does “nocturnal” mean?

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

6. Can you name any nocturnal animals?

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________

7. Some animals use their eyes to look for food. Can you think of any other ways an animal might look for food?

   __________________________________________________________
   __________________________________________________________
   __________________________________________________________
Interest Assessment

Great job, you are so smart! Now I’m going to ask you some questions about what kinds of things you like to do. Remember there are no right or wrong answers. I just want to hear what you think.

[For each question, circle one of the response options]

Interest in Narrative Content
1. Would you like to have a sleepover party?
   YES     NO
   [If yes] How much would you like to have a sleepover party?
          A LITTLE, A LOT, or A WHOLE LOT

2. If you could, would you like to try to stay up all night and go on an adventure?
   YES     NO
   [If yes] How much would you like to do that?
          A LITTLE, A LOT, or A WHOLE LOT

3. If you could, would you like to go on an adventure into the forest where you could meet different animals?
   YES     NO
   [If yes] How much would you like to do that?
          A LITTLE, A LOT, or A WHOLE LOT

Interest in Educational Content
1. Would you like to learn about how we use our senses, like seeing, hearing, and smelling?
   YES     NO
   [If yes] How much would you like to learn about that?
          A LITTLE, A LOT, or A WHOLE LOT

2. Would you like to learn about how different animals find food?
   YES     NO
   [If yes] How much would you like to learn about that?
          A LITTLE, A LOT, or A WHOLE LOT

3. Would you like to learn about animals who stay up all night and sleep in the daytime?
   YES     NO
   [If yes] How much would you like to learn about that?
          A LITTLE, A LOT, or A WHOLE LOT
Interest in Viewing

1. Would you like to watch a TV show about the Cat in the Hat and his friends having a sleepover party?
   YES  NO
   [If yes] How much do you want to watch something like that?
   A LITTLE, A LOT, or A WHOLE LOT

2. Would you like to watch a TV show about a science adventure into the forest to meet different kinds of animals?
   YES  NO
   [If yes] How much do you want to watch something like that?
   A LITTLE, A LOT, or A WHOLE LOT

3. Would you like to watch a TV show about animals who stay up all night?
   YES  NO
   [If yes] How much do you want to watch something like that?
   A LITTLE, A LOT, or A WHOLE LOT

Great, thank you for answering all of those questions! You’re doing a great job! Now here is fun part. You are going to watch an episode of a show called The Cat in the Hat Knows A Lot About That! I want you to watch very carefully because I’m going to ask you some questions about it afterwards. Here we go.
[If child gets distracted and needs to be reoriented, say, “Don’t forget to watch carefully. I’m going to ask you some questions about it afterwards.”]

[If there are noisy distractions, say, “I’m sorry that it’s so noisy in here. I know it’s a little hard to hear, but please try the best you can to pay attention to the show.”]

☐ Yes, child has viewed the episode in its entirety

Viewing Notes
(Record anything noteworthy about the viewing environment and/or the child’s actions while viewing):
Story Schema Assessment
Okay, now that you've seen the video, I'm going to show you some pictures from the video! Just do the best you can.

Sequencing Task
These pictures show different things that happened in the story. Can you put the cards in the order that they happened in the story? Put the picture that happened first over here, and out the picture that happened last over at this end.

______  ______  ______  ______  ______  ______  ______

Sorting Task
Can you point to the picture that shows the most important thing that happened in the story?

______

Can you point to the next most important thing that happened?

______

Can you point to the next most important thing that happened?

______
Narrative Comprehension Assessment

Great job! Now I’m going to show you some pictures and ask you some questions about the episode you watched. If you don’t know an answer, that’s okay! Just do the best you can.

NC_1. At what time of day did the story take place? (C)
   a. Morning
   b. Afternoon
   c. Nighttime [correct]

NC_2. What were Nick and Sally trying to make for their sleepover? (IC)
   a. A pillow fort [correct]
   b. Dinner
   c. Goggles

NC_3. What did the Cat lose? (C)
   a. The thingamajigger
   b. The fish
   c. His hat [correct]

NC_4. What does the team use to see in the dark?
   a. Lights
   b. Owl goggles [correct]
   c. Bat ears

NC_5. How does the team get to the Forest of Whagamaroo? (IC)
   a. They walk
   b. They take the thingamajigger [correct]
   c. They swim

NC_6. Who was the first animal the team found in the forest? (C)
   a. The Bat
   b. The Owl [correct]
   c. The Opossum

NC_7. What animal did Nick and Sally find hanging upside down? (C)
   a. The Owl
   b. The Opossum
   c. The Bat [correct]
NC_8. What animal do Nick, Sally, and the Cat hear with their special bat ears? (C)
   a. The Opossum [correct]
   b. The Owl
   c. The Bat

NC_9. How does the team find the Cat’s hat? (C)
   a. With their owl goggles
   b. With their bat ears
   c. With their opossum noses [correct]

NC_10. What surprise did the Cat have inside his hat for Nick and Sally? ([C]
   a. A feast [correct]
   b. Bongo drums
   c. A guitar

Educational Content Comprehension Assessment
You’re doing such a great job! I’ve got a few more questions for you, and then we’ll be all done!
[If child does not respond, probe: Can you think of anything?]
[If child give single response, probe up to 2 times: Anything else?]

ECC_1. What senses can we use to help us find things?

ECC_2. What does nocturnal mean?

ECC_3. Can you name any nocturnal animals?

ECC_4. Some animals use their eyes to look for food. Can you think of any other senses animals can use to help them find food?
ECC_5. Who is best at seeing in the dark?
   a. Humans
   b. Owls [correct]
   c. Bats

ECC_6. Bats are especially good at using which sense?
   a. Smelling
   b. Hearing [correct]
   c. Tasting

ECC_7. How do owls see at night?
   d. With their special eyes [correct]
   e. With goggles
   f. With flashlights

ECC_8. Why do bats hang upside down?

ECC_9. Who can hear bats?
   g. Humans
   h. Only other bats [correct]
   i. Owls

ECC_10. What sense does an opossum use to look for its food?
   j. Seeing
   k. Hearing
   l. Smelling [correct]

Okay, we are all finished! Thank you so much for helping me. You did a wonderful job! I have some stickers to give you for being such a great helper.

[Make sure child is escorted back to the classroom. Take time to set up for the next child before moving on.]
Appendix C: Visuals Used in Testing Session
Figure 1. Short-Term Memory Assessment
Figure 2. Story Schema Assessment

Continued
Figure 2 continued
Continued

Figure 3. Narrative Comprehension Assessment
Figure 4. Educational Content Comprehension Assessment