The Relationship between Narrative Processing Demands and Young American Children’s Comprehension of Educational Television

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Abstract

Fisch’s capacity model provides a theoretical explanation for how children comprehend educational content within an educational television program. The model focuses on children’s allocation of their limited cognitive resources, with attention to the resources used for comprehending the narrative versus the educational content within the show. The model predicts that, when narrative processing demands are reduced, narrative comprehension will be improved. Reduced narrative demands are also expected to support educational content comprehension as greater cognitive resources are available to process the content. This prediction was tested with 172 American children (102 females, $M = 4.2$ years). Narrative processing demands were operationalized via story schema. Results from a correlational analysis supported predictions. Advanced story schema was associated with improved narrative and educational content comprehension. Implications are discussed.

*Keywords:* capacity model, children, comprehension, educational television, narrative, story schema
The Relationship between Narrative Processing Demands and Young American Children’s Comprehension of Educational Television

Since its inception, television’s impact on children has been met with concerns. These concerns have fueled over fifty years of research on the role that television plays in the lives of children and has been the impetus for much of the media policy in the United States. While some concerns have been debunked (e.g., television induces passivity and results in shorted attentioned span in children, see Anderson, 1998 for a review), others remain important venues for continued research and legislation (e.g., sexual content, Bleakley, Hennessy, Fishbein, & Jordan, 2008; violent content, Huesmann, Moise-Titus, Podolski, & Eron, 2003). Implicit in these concerns is the notion that children can and do learn from television. And while the negative lessons deserve the attention they receive by researchers and policy makers, if researchers subscribe to the notion that television can teach, then it stands to reason that television can offer its viewers positive lessons as well (Fisch, 2004). This contention is widely supported with researchers making the critical point that when programs are “designed with research-based knowledge of how children use and understand television and when they are designed to incorporate systematic academic or social curricula, children benefit” (Schmidt & Anderson, 2007, p. 79).

The focus of this study is on educational television designed for preschool-aged children (i.e., children 3 to 5 years old). There has been dramatic growth in the educational television landscape for preschoolers in recent decades. This growth is attributable to changes in the regulatory environment (Jordan, 2004), the growth in niche cable channels targeting preschoolers (e.g., Home, 2011; Szybist, 2011), a surge of research on the importance of early childhood development, and lastly, a realization by television producers that preschool television can make money (Hendershot, 2004; Hendriyani, Hollander, d'Haenens, & Beentjes, 2011). This crowded
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landscape, coupled with estimates which suggest that 67% of preschoolers watch television daily (American estimates, Common Sense Media, 2013; similar patterns in other industrialized countries, see Szybist, 2011), highlights the need for research on ways to support the educational outcomes that preschoolers can experience when viewing educational television.

**How Children Learn from Educational Television**

Most discussions of children’s learning from television center on learning experiences that lead to transfer, or the ability to extend what has been learned in one context to new contexts (Byrnes, 1996). And while television has supported transfer (e.g., Bryant et al., 1999; Friedrich & Stein, 1973; Huesmann, 1986; Linebarger & Piotrowski, 2008), the findings are inconsistent (Fisch, Kirkorian, & Anderson, 2005). Bransford & colleagues (1999) highlight three factors that influence successful transfer: (1) the mastery of the original content, (2) the mental representation of the original content, and (3) the transfer situation. Researchers (Fisch et al., 2005; Singley & Anderson, 1989) argue that the absence of consistent transfer effects is likely indicative of poor mastery of the original content rather than demonstrative of the medium’s inability to support transfer. Finding ways to support children’s initial comprehension of the educational content in a television program is an important goal.

Despite the importance of ensuring that children comprehend the educational content embedded within educational television programs, Fisch (2000) posits that the field knows little about how this learning process occurs. In response to the dearth of theoretical approaches available to explain how young viewers extract and comprehend educational television content, Fisch (2000, 2004) presented a systematic model of comprehension (referred to as the capacity model) with its roots in information processing research (e.g., Lang, 2000). Central to the model is the supposition that working memory is limited and, for effective processing, the viewing
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demands cannot exceed the available resources in working memory. Work with adult audiences
supports this contention (Lang, 2000) - when television processing demands exceed the capacity
of working memory, comprehension is impaired.

The capacity model focuses on children’s allocation of cognitive resources during
television viewing, with specific attention to the degree to which working memory resources are
allocated to comprehension of the narrative versus the educational content. Narrative content is
defined as content which presents the story in the program whereas educational content is the
underlying educational concept which the program is intended to convey (Fisch, 2000).

Demands for cognitive resources are said to come from three basic elements: narrative
processing, educational content processing, and the distance between the two. When the
narrative and educational content are tangential, the two processes compete for limited resources
in working memory and result in impaired comprehension of the educational content. When the
educational content is integral to the narrative, the two processes become complementary and
educational content comprehension strengthened. The capacity model further predicts that
factors that allow for more efficient processing of either content type will reduce processing
demands associated with that content thus increasing comprehension.

Fisch (2004) argues that all televised presentations of educational content include
narrative. Narrative content consists of three forms of content: central, inferential, and incidental
(Collins, Wellman, Keniston, & Westby, 1978). Central content is essential content that is
explicitly presented in the program while inferential content is essential content that is implied
by events shown on screen. Incidental content is content that is nonessential to plot
understanding. Inferential processing is considered more sophisticated than central content
processing (Collins et al., 1978), and successful incidental content comprehension in the face of
weak central or inferential content comprehension suggests that the narrative was incorrectly processed (Thorndyke & Yekovich, 1979). Educational content, on the other hand, is content that has been purposefully included in the television narrative to support academic or prosocial skills of viewers (Fisch, 2004). Compared to the relatively large knowledge base related to narrative processing (Collins et al., 1978; Meadowcroft & Reeves, 1989; Newcomb & Collins, 1979), much less is known about how children process educational content in television programs (Fisch, 2000, 2004).

The capacity model posits several principles to help determine allocation of resources to the narrative and educational content (Fisch, 2000, 2004). Because television is primarily an entertainment medium, the viewer is said to give priority to comprehension of the narrative over the educational content. The cognitive resources available to process educational content are thus a function of the amount of resources not already committed to the narrative. And while viewers can allocate resources differentially, narrative processing can never be abandoned in favor of educational content. As a result, the model predicts that educational content comprehension will increase when narrative demands are reduced. While some research provides indirect support for the capacity model (Lauricella, Gola, & Calvert, 2011; Smith, Anderson, & Fischer, 1985), no existing work has tested the prediction that reduced narrative demands will lead to improved educational content comprehension. This research begins to address this gap by evaluating how children’s educational television comprehension is affected when narrative demands are reduced.

**Reducing Narrative Processing Demands**

Narrative processing has received much attention in the print-based literature (e.g., Best, Floyd, & McNamara, 2008; McCabe & Peterson, 1991; Trabasso & Stein, 1997), and as a result, a considerable amount is known about how processing can be both taxed and reduced. Television
viewers engage in many of the same processes used in reading, and thus print-based findings are argued to translate to television (Kendeou, Bohn-Gettler, White, & Van Den Broek, 2008; Linebarger & Piotrowski, 2009; Neuman, 1995). Story schema research is one area that has translated from print to television.

Defined as “memory structures which consist of clusters of knowledge about stories and how they are typically structured” (Meadowcroft, 1986, p. 7), story schema develops through exposure to stories that conform to the prototypical story grammar (Mandler & Johnson, 1977; Stein & Glenn, 1979). With time, story schemas accommodate new information and become significantly more complex (Thorndyke & Yekovich, 1979). Story schema organizes content via instantiation (i.e., matching incoming information to schema elements) (Thorndyke & Yekovich, 1979). This ensures that the incoming story information is organized in a coherent manner, and subsequently facilitates comprehension by reducing the effort associated with encoding and recalling the content. As such, well-developed story schemas are said to reduce the demands associated with narrative processing. Print-based research supports this argument. Children with well-developed story schema tend to be better readers (Rahman & Bisanz, 1986); are more likely to produce organized story writing (Fitzgerald & Teasley, 1986); and are better able to comprehend and recall text-based narratives (Buss, Yussen, Mathews II, Miller, & Rembold, 1983). Children as young as four are sensitive to the structural features of narrative (van den Broek, Lorch, & Thurlow, 1996) and can employ their developing story schema to aid in describing and recalling picture-based narratives (Poulsen, Kintsch, & Kintsch, 1979). And yet while most scholars agree that television viewing is at least partly schema driven (e.g., Anderson & Lorch, 1983; Bordeaux & Lange, 1991; Lorch, Bellack, & Augsbach, 1987; Luke, 1987), research on the role that story schema plays in television comprehension is limited.
Newcomb & Collins (1979) paved the way for additional research on the role that story schema plays in comprehension. In their research, they asked whether previous age-based findings represented young children’s incapacity for narrative processing or whether it reflected unfamiliarity with the television content. Results supported a schematic-process to television viewing - children’s difficulties in comprehending narratives were less pronounced when the stimuli information was congruent with prior social experience. Collins and Wellman (1982) provided additional support for schematic processing when they illustrated that younger children, comparative to older children, made more errors in comprehending uncommon television plots and were more likely to fill in gaps with stereotypes of common action sequences.

While the research by Collins and colleagues reflected an interest in how social schemas impact narrative processing, Meadowcroft & Reeves (1989) took the next step to evaluate how story schema impacts children’s (aged 5 to 8 years) attention to and comprehension of a television narrative. Children with strong story schema allocated less attention to processing television stories than low story schema children. Unexpectedly, all children paid more attention to central than incidental content. However, increased schema predicted improved memory of central story content. This difference was not present for incidental content comprehension. The results supported the argument that advanced story schema influences narrative processing by offering strategies for attending to and remembering narratives (Meadowcroft & Reeves, 1989).

Meadowcroft & Reeves (1989) made inroads into our understanding of how narrative processing skills impact children’s comprehension of television, however, the research can be extended. Their research studied children between the ages of five and eight, yet newer research suggests that children as young as three demonstrate story schema skills (Ilgaz & Aksu-Koc, 2005). Based on existing research, advanced story schema skills should support preschoolers’
central content comprehension (H1). It is unclear, however, what role story schema may play in incidental content comprehension. Story schema should not be associated with incidental content comprehension. Yet, Meadowcroft & Reeves (1989) found that advanced story schema was associated with greater attention to incidental content. Although attention differences did not translate to comprehension differences, it is important to investigate how story schema may be associated with incidental content comprehension (RQ1). Lastly, it is unknown how story schema impacts inferential or educational content processing. Inferential comprehension reflects deeper, more sophisticated processing (Collins, 1979; Kendeou et al., 2008; Salomon, 1983). Advanced story schema should increase the efficiency of central content processing, and by virtue of this increased efficiency, allow more resources for inferential processing (H2). Further, Fisch’s capacity model (2000, 2004) predicts that more advanced story schema will support educational content comprehension because the demands associated with processing the narrative content will be less (H3). The present study tests the predictions that story schema is positively associated with central, inferential, and educational content comprehension and asks whether story schema is related to incidental content comprehension.

H1. Preschoolers’ story schema skills will be positively associated with central content comprehension.

RQ1. What is the relationship between preschoolers’ story schema skills and incidental content comprehension?

H2. Preschoolers’ story schema skills will be positively associated with inferential content comprehension.

H3. Preschoolers’ story schema skills will be positively associated with educational content comprehension.

Method

Research Design
Given that story schema is an individual difference variable, a correlational design was used to evaluate the relationship between story schema and program comprehension (4 dependent variables: central, incidental, inferential, and educational content comprehension).

**Participants**

After receiving approval from the Institutional Review Board at the sponsoring university, children were recruited from nineteen childcare centers in an urban city in the United States. Participating classrooms were compensated $100 for use at an educational supply store, children received a child’s book and sticker, and parents who completed a parent survey were compensated $20. A total of 209 consent forms were returned. Seventeen children were dropped from analyses because of incomplete data due to child absence. Of the remaining 192 children, 20 were dropped from final analyses because of age. Children were required to be between 3 years, 0 months old and 5 years, 1 month old on the date of pretest in order to participate. This age criterion was based upon previous research on the development of children’s narrative skills (Ilgaz & Aksu-Koc, 2005) and children’s working memory capacity (Dempster, 1981).

Of the 172 children, females represented 59.3% (n = 102) of the sample. The average age of the children in the sample was 4.20 years (SD = .50). Since story schema is a developmentally associated construct, it was expected that age would be a positive correlate of story schema. This expectation was confirmed ($r = .19, p < .05$). Additional demographic information and children’s home media use information was gathered via parent surveys (92% return rate, see Table 1). Story schema was not associated with any of the demographic variables. It was positively associated with one media use variable – computer time ($r = .19, p < .05$).

**Procedures**
To avoid participant fatigue, the research required two testing sessions. The first session was conducted 7 to 10 days before the second session. All testing was conducted within available spaces at the children’s schools (e.g., empty classrooms). During the first session, children completed program familiarity, educational content knowledge, and story schema assessments. During the second session, children viewed an episode of Dora the Explorer that has been used in previous research (Calvert, Strong, Jacobs, & Conger, 2007). Viewing was completed individually with only the researcher present. The researcher was ostensibly “doing homework” to avoid biased attention to the stimuli (see Calvert et al., 2007). Crayons and paper were available during the viewing. Viewing was videotaped for potential post hoc analyses. After viewing, children completed the narrative and educational content comprehension assessments.

**Stimuli**

To address hypotheses, the stimulus needed to meet several requirements. Because story schema cannot aid in processing content that violates schema expectations, the stimulus needed to conform to a prototypical story structure (Mandler & Johnson, 1977; Meadowcroft, 1986; Stein & Glenn, 1979). The stimulus also needed to have educational content integrated within the narrative (Fisch, 2000), target preschoolers, and be shown to be appealing to preschoolers. Dora the Explorer met these requirements. Content analytic work has revealed that Dora the Explorer has a strong prototypical narrative structure (Piotrowski, 2007). The show embeds educational content within a narrative plotline with a specific emphasis on Spanish language skills, math and visual skills, music skills, and physical coordination. And, in terms of appeal, the show is one of the most popular programs viewed by American preschoolers (Nielsen Media Research, 2011).

The episode Sticky Tape was selected for this study as this episode has been used successfully in other research with preschoolers (Calvert et al., 2007). In this episode, Dora and
Boots set out to save Benny the Bull, whose hot air balloon is going to crash because it has a hole in it. Dora and Boots decide they need to use sticky tape to fix the balloon. As they try to reach Benny, they encounter a number of obstacles that they must solve including (1) fixing the holes in the sail of a boat so they can get across the windy river, (2) using sticky tape on their shoes to help them gain traction to climb over the slippery rock, and (3) using sticky tape to fix Benny’s balloon right before it falls into Crocodile Lake. The episode ends as Benny is saved and the characters celebrate their success (description adapted from Calvert et al., 2007).

**Measures**

**Story schema task.** Each participant completed the Story Schema Task during the first testing session. Following procedures described by Meadowcroft (1986), children first viewed a short television narrative that conformed to the prototypical narrative structure (Mandler & Johnson, 1977; Stein & Glenn, 1979). An 11 minute episode of the television program *Franklin* was used (episode: Franklin Goes to School). After viewing, each child completed an assessment measuring the child’s ability to distinguish between central and incidental content in the television narrative (sorting task) and the child’s ability to arrange the television narrative events in correct temporal order (sequencing task). Both skills are fundamental to the development and use of story schema (Brown, 1975; Meadowcroft & Reeves, 1989). The final score was represented by summing the standardized sorting and sequencing scores ($M = -0.08$, $SD=1.39$, Range = -2.89 to 3.07). Previous research with older children (age 5-8, Meadowcroft, 1986) indicates that this scale meets the criteria for predictive and construct validity. Pilot tests of this measure with children aged 3-5 provide evidence for convergent validity (Piotrowski, 2010). See Piotrowski, 2010 for more details on the design and administration of this measure.
Narrative content comprehension. Each participant completed the narrative content comprehension assessment during the second testing session after viewing the testing stimuli. The assessment measured the three domains of narrative content comprehension: central, inferential, and incidental content comprehension. To create the assessment, procedures developed by Collins (1970) were followed (see Piotrowski, 2010 for details). A total of 20 questions (10 central, 6 incidental, 4 inferential) were analyzed. Three response options were pictorially represented for central and incidental questions. A sample central item is “Why does Benny need sticky tape? (a) to fix his backpack, (b) to fix his balloon, or (3) to fix the rope ladder.” A sample incidental item is “What does Dora drop on the way to the Windy River? (a) her teddy bear, (b) Backpack, or (c) the map.” To create stylistically equivalent response options, episodes of Dora the Explorer were digitally captured to create screen shots of episode scenes. These screen shots were edited using professional editing software. For inferential questions, an image was selected from the episode to help cue the child to the scene but no responses options were provided. A sample inferential question is “What will happen if Benny’s balloon goes into the lake?”

For central and incidental questions, correct answers received one point while incorrect answers received zero points. Inferential questions relied on open-ended responses that were awarded 0 to 2 points. All open-ended responses were independently scored by the researcher and a trained research assistant. Krippendorff’s alpha (Hayes & Krippendorff, 2007) indicated strong intercoder reliability ($\alpha = .93$). Cronbach’s alpha yielded acceptable internal consistency for central, incidental, and inferential comprehension ($\alpha_{\text{central}} = .89; \alpha_{\text{incidental}} = .78; \alpha_{\text{inferential}} = .73$). Composite scores were created with higher scores reflecting greater comprehension ($M_{\text{central}}$...
= 7.49, SD = 2.49, Range = 1.0 to 10.0; M incidental = 4.42, SD = 1.56, Range = 0.0 to 6.0; M inferential = 3.93, SD = 2.13, Range = 0.0 to 8.0).

**Educational content comprehension.** Each participant completed the 26 question educational content comprehension assessment during the second testing session after viewing the testing stimuli. The director of Research and Development for *Dora the Explorer* provided a list of the educational goals embedded in the narrative of the *Sticky Tape* episode (M. Diaz-Wionczek, personal communication, October 24, 2008). Those goals that lent themselves to evaluation were included in the assessment (e.g., goals included learning how to read the map used in the show, shape identification (circle), color recognition (yellow), enumeration and receptive understanding of the numbers 1 through 5 in English, and enumeration, definition, and receptive understanding of the numbers 1 through 5 in Spanish; see Piotrowski, 2010). The scores across the 26 items were summed to create a composite score with higher scores representing greater comprehension of the educational content (M = 18.75, SD = 5.80, Range = 4.0 to 33.0).

**Pretest educational content knowledge.** To control for prior knowledge of the educational content, a version of the educational content comprehension assessment was created and administered during the first testing session. The pretest was identical in content to the posttest assessment, with the exception that any mention of *Dora the Explorer* was omitted and replaced (where necessary). This assessment consisted of 25 questions, one less than the posttest assessment because the pretest corollary for one of the items was only one question. The scores across the 25 items were summed to create a composite score with higher scores representing greater knowledge of the educational content (M = 16.70, SD = 4.57, Range = 5.5 to 28.50).
Program familiarity. Because program familiarity may play a role in how children experience the stimulus (Crawley et al., 2002), all participants completed a program familiarity assessment during the first testing session. The assessment contained sixteen images of Dora the Explorer characters, representing both main and secondary characters. Children were asked to name the character for all questions. Correct responses received 1 point, partially correct responses received ½ point, and incorrect responses received no credit. This approach to measuring familiarity has been used successfully in other research studies as well (de Droog, Valkenburg, & Buijzen, 2011). Higher scores indicated greater familiarity with Dora the Explorer ($M = 8.24$, $SD = 3.45$, Range = 0.0 to 16.0).

Analytic Approach

Because the sample is nested within schools, ordinary least-squares regression (OLS) was inappropriate as the assumption of independent observations is violated. This can result in over-or-underestimation of coefficients due to biased estimates of standard errors (Desai & Begga, 2008; Hayes, 2006). To address this clustering in the data, multilevel modeling was used in Stata 12. Multilevel models take into account that some variables are clustered or nested within other variable (in our case, children were nested within schools). The correlation among children within a school is accounted for by allowing the intercept of the regression equation to vary freely across schools. This results in appropriate estimates of the standard errors for the regression coefficients (Desai & Begga, 2008). Parameters in this multilevel model can be interpreted in the same way as OLS regression.

All models controlled for children’s age at pretest and familiarity with Dora the Explorer. Because data come from a larger between-subjects factorial experiment (experimental manipulation results presented elsewhere, Piotrowski, 2010; 2013), two controls were included
to extract the variance associated with those manipulations. Educational knowledge at pretest was also included as a covariate in the analytic model predicting educational content comprehension. Lastly, given the relationship between story schema and computer use (noted above), all media use variables (see Table 1) were investigated in conjunction with the dependent variables to determine if any were appropriate covariates. Weekly computer use was the only media use variable associated with the dependent variables. Due to this unexpected relationship with story schema and the relationship with the dependent variables, weekly computer use was evaluated as a potential covariate for all planned models following procedures described by Darlington (1996). This variable was found to be an insignificant correlate of study outcomes when combined with other independent variables and thus inappropriate for model inclusion.

All model assumptions were tested and confirmed. Table 2 presents bivariate correlations for model variables. Table 3 presents a full accounting of each model.

**Results**

Hypothesis 1 posited that story schema will be positively associated with central content comprehension. As shown in Table 3, when adjusted for model covariates, story schema remains a positive correlate of central content comprehension ($B = .29, z = 2.46, p < .05$). Hypothesis 1 was supported.

Recall that a research question was posited regarding the relationship between story schema and incidental content comprehension. Results indicate that, when adjusted for model covariates, story schema is positively associated with incidental content comprehension ($B = .27, z = 3.52, p < .05$).

Hypothesis 2 posited that story schema will be positively associated with children’s inferential content comprehension. Results indicate that, after adjusting for model covariates,
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story schema is positively associated with inferential content comprehension ($B = .33, z = 3.30, p < .05$). Hypothesis 2 was supported.

Lastly, hypothesis 3 posited that story schema is positively associated with educational content comprehension. After adjusting for model covariates, including pretest educational knowledge, results indicate that story schema is positively associated with educational content comprehension ($B = .57, z = 3.09, p < .05$). Hypothesis 3 was supported.

Discussion

The capacity model is a theoretical model designed to explain how children learn from educational television (Fisch, 2000, 2004). Central to the model is the notion that working memory is limited, and if content is to be processed effectively then the demands of the viewing task must not exceed the available resources. The capacity model posits that when narrative processing demands are reduced, narrative content will be more easily comprehended. The model further predicts that reduced narrative processing will translate to improved educational content comprehension because greater cognitive resources are available to process that content. Operationalized as story schema skills, this study tested the capacity model’s predictions that reduced narrative processing demands will be associated with improved comprehension of both the narrative and educational content within an educational television program.

Results supported the predictions of the capacity model. More sophisticated story schema was associated with increased central, inferential, and educational content comprehension. Considering that many researchers believe that the absence of consistent transfer effects from educational television is an artifact of poor mastery of the program content (Fisch et al., 2005; Singley & Anderson, 1989), these findings are encouraging. They highlight the power of children’s story understanding as a mechanism for supporting comprehension of an educational
television program. The challenge, however, is learning how to support the development of these story skills – particularly for children most at-risk for story schema deficits. Story schema develops through exposure to stories that conform to the prototypical story structure (Mandler & Johnson, 1977; Stein & Glenn, 1979). Supporting efforts to enhance children’s story skills as well as investigating new ways to enhance these story skills is an important next step. For example, Linebarger & Piotrowski (2009) found that repetitive exposure to simple television narratives which employ a prototypical story structure can bolster the story schema skills of preschool children at-risk for these deficits.

Interestingly, in addition to supporting central, inferential, and educational comprehension, story schema was also positively associated with incidental content comprehension. Recall that successful incidental content comprehension in the face of weak central or inferential processing is an indicator that the narrative was incorrectly processed (Thorndyke & Yekovich, 1979). Story schema was positively associated with central and inferential comprehension in this study, thus there are few concerns related to inaccurate narrative processing. However, it is possible that the effects of story schema on central, inferential, and educational content could have been stronger had the incidental content not drawn on cognitive resources. Posthoc analyses of children’s attention to the stimuli by content type indicate that incidental content elicited the greatest attention, independent of the child’s story schema level (Piotrowski, 2010). This suggests that the incidental content was highly salient in the stimuli. It is possible that this salience may have encouraged children with more advanced story schema to allocate greater cognitive resources to processing this content. Most research on the role of story schema in narrative processing has investigated its role in the comprehension of print-based narratives. It may be that, by virtue of the audiovisual
presentation, incidental content is more salient and thus more easily recalled by children who have greater cognitive resources available. If this is true, it is also reasonable to expect that performance on other forms of comprehension would suffer. Posthoc analyses do not support this argument, although the minimal variance in incidental comprehension among children with more advanced schema is possibly inhibiting the ability to detect this pattern. Alternatively, Dora the Explorer’s presentation and inclusion of incidental content may be unique. Expanding this research with alternative stimuli would be an important next step. From a program development perspective, if cognitive resources are being directed away from more important processing because of incidental content saliency, decreasing the saliency of this content is advisable.

More broadly, these findings are encouraging as they provide support for the capacity model as a mechanism for understanding how children learn from educational television. There are limited theories available to explain how young children process media, particularly educational television content. Story schema is only one way to reduce narrative processing demands, and this variable is most applicable to content that conforms to prototypical narrative structures. There are many other ways to reduce narrative demands that are not as closely tied to the story structure (e.g., child’s prior knowledge or subject matter interest; including advance organizers or decreasing the need for narrative inferences). In fact, one of the control variables used in this study, familiarity with Dora the Explorer, reflects a form of prior knowledge. And, as the analyses show, familiarity was positively associated with comprehension, providing additional support for the model (see Piotrowski, 2013 for a greater discussion on the role of familiarity). Researchers are encouraged to investigate other ways to support children’s learning from educational television, including television programs that do not conform to the prototypical narrative structure. Moreover, based on the findings presented here, researchers are
encouraged to consider the capacity model as a potential theoretical framework to help guide these investigations.

**Limitations**

Participants in this sample represented a convenience sample, thus it is unknown whether or how these findings generalize to other preschool-aged viewers. The setting for the viewing and testing was a non-normative one. Children’s comprehension of the television content may differ from what would be expected in a more naturalistic viewing environment. To reduce this concern, viewing areas were set up with children’s furniture and an alternative activity (coloring) but the external validity threat remains. It is also important to note that pretest data revealed that children in the study knew a good deal of educational content prior to viewing. All participants attended childcare where many of the educational content messages were likely taught. The findings for educational content comprehension may have been strengthened had the children known less of the content at study onset.

The study design does not permit assessment of causality. While researchers (Meadowcroft & Reeves, 1989) have been able to investigate story schema experimentally by obtaining story schema scores from all children in advance and then randomly assigning these children to different study conditions, a similar approach was determined to be an infeasible option given the desired sample size. Relatedly, due to the correlational nature of the data, there is some question as to whether these findings reflect story schema per se or instead if story schema is a proxy for other cognitive skills (e.g., general cognitive ability, vocabulary). Although not reported here, normative data on children’s vocabulary development was collected in the study to help reduce this concern. Initial analyses indicated that the inclusion of both child’s age and vocabulary introduced significant multicollinearity in the models, thus decreasing
the stability of the standard errors. Age was found to be a stronger and more consistent predictor of the dependent variables. As a result, age was included in models whereas vocabulary was omitted. Keeping in mind the instability of the standard errors, when including both age and vocabulary in the model, story schema did remain a significant correlate of all four comprehension types. To help address these limitations associated with the design, a follow-up research study which employs an experimental procedure is a reasonable next step.

This study would have also benefitted from a direct measurement of children’s capacity usage during viewing – perhaps, for example, through a secondary task reaction time (STRT) protocol (e.g., Lorch & Castle, 1997). Given the main outcome of interest was program comprehension, there was concern that an STRT protocol would have distracted the children too much from viewing. This concern, combined with the desire to facilitate a more naturalistic viewing experience, resulted in the decision to omit STRT in this study. Instead, an effort was made to ensure that the eligible age range in this study was small in order to minimize differences in working memory capacity (Dempster, 1981; Pascual-Leone, 1970). Inclusion of STRT, or a similar protocol, in future research looking specifically at media content processing is justified. Lastly, only one stimulus was used in this study. It is possible that there are unique characteristics about Dora the Explorer that may explain these effects. Replication of this research with an additional stimulus is appropriate.

Conclusion

This study reminds us that what children bring to the viewing experience plays a role in what they learn from the medium. Preschoolers’ story schema was positively associated with both narrative and educational content comprehension. These findings support existing efforts to create preschool-targeted educational television which integrates educational content within a
prototypical story structure. This research also highlights the potential role of Fisch’s capacity model as a theoretical construct for investigating how children learn from television. And lastly, these findings suggest that the stories our children read and hear can provide them with skills to help enhance the potential of educational television.
References


experiences with *Blue’s Clues* on preschool children's television viewing behavior.


*Psychological Bulletin, 89*(1), 63-100. doi: 10.1037/0033-2909.89.1.63


Footnotes

1 For example, in an episode of the children’s television program *The Magic School Bus* titled “Gets Planted”, a character (Phoebe) has been charged with growing a vine for her school’s production of Jack and the Beanstalk. During this narrative, we see that Phoebe is having trouble growing the vine so she asks for help. With the help of her teacher, her friends, and the Magic School Bus, Phoebe learns about photosynthesis (the educational content embedded within the narrative of the show) and is able to use her knowledge to grow a vine for the school play.

2 Franklin is an animated narrative-based television show featuring Franklin, a 6-year old turtle. In each episode, viewers watch stories about the challenges, adventures, and situations that Franklin and his friends encounter. The program utilizes a split-episode framework composed of two 11-minute episodes separated by a bumper or interstitial. For the story schema task, one eleven-minute episode was selected.
Table 1

Demographic & Home Media Characteristics of Study Sample

<table>
<thead>
<tr>
<th>Variable</th>
<th>Percentage or M (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Child Age (years)</td>
<td>4.25 (.50)</td>
</tr>
<tr>
<td>Child Gender</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>40.7%</td>
</tr>
<tr>
<td>Female</td>
<td>59.3%</td>
</tr>
<tr>
<td>Child Disability</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>88.4%</td>
</tr>
<tr>
<td>Yes</td>
<td>2.3%</td>
</tr>
<tr>
<td>Not Reported</td>
<td>9.3%</td>
</tr>
<tr>
<td>Child Race</td>
<td></td>
</tr>
<tr>
<td>White</td>
<td>26.7%</td>
</tr>
<tr>
<td>African American</td>
<td>49.4%</td>
</tr>
<tr>
<td>Other Race</td>
<td>13.4%</td>
</tr>
<tr>
<td>Not Reported</td>
<td>10.5%</td>
</tr>
<tr>
<td>Child Ethnicity</td>
<td></td>
</tr>
<tr>
<td>Not Latino</td>
<td>76.7%</td>
</tr>
<tr>
<td>Latino</td>
<td>10.5%</td>
</tr>
<tr>
<td>Not Reported</td>
<td>12.8%</td>
</tr>
<tr>
<td>Parent Education (Respondent)</td>
<td></td>
</tr>
<tr>
<td>High School or Less</td>
<td>20.9%</td>
</tr>
<tr>
<td>Some College</td>
<td>24.4%</td>
</tr>
<tr>
<td>Vocational or Trade School</td>
<td>12.2%</td>
</tr>
<tr>
<td>Bachelor’s Degree or Greater</td>
<td>31.4%</td>
</tr>
<tr>
<td>Not Reported</td>
<td>11.0%</td>
</tr>
<tr>
<td>Employment Status (Respondent)</td>
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</tr>
<tr>
<td>Full Time</td>
<td>69.8%</td>
</tr>
<tr>
<td>Other (Part, Self, Homemaker)</td>
<td>6.4%</td>
</tr>
<tr>
<td>Not Working</td>
<td>9.9%</td>
</tr>
<tr>
<td>Multiple Status</td>
<td>5.8%</td>
</tr>
<tr>
<td>Not Reported</td>
<td>8.1%</td>
</tr>
<tr>
<td>Marital Status (Respondent)</td>
<td></td>
</tr>
<tr>
<td>Married / Living as Married</td>
<td>40.7%</td>
</tr>
<tr>
<td>Not Presently Married</td>
<td>9.3%</td>
</tr>
<tr>
<td>Never Married/ Single</td>
<td>40.7%</td>
</tr>
<tr>
<td>Not Reported</td>
<td>9.3%</td>
</tr>
<tr>
<td>Income-to-Needs Ratio</td>
<td></td>
</tr>
<tr>
<td>Poverty (&lt; 1.0)</td>
<td>14.0%</td>
</tr>
<tr>
<td>Near Poverty (1.0 – 1.99)</td>
<td>23.8%</td>
</tr>
<tr>
<td>Working Class (2.0 – 2.99)</td>
<td>9.3%</td>
</tr>
<tr>
<td>Middle &amp; Upper Class (&gt; 3.0)</td>
<td>26.7%</td>
</tr>
<tr>
<td>Not Reported</td>
<td>26.2%</td>
</tr>
<tr>
<td>Child Weekly Media Use (minutes)</td>
<td></td>
</tr>
<tr>
<td>TV Viewing</td>
<td>582.05 (560.68)</td>
</tr>
<tr>
<td>Video Viewing</td>
<td>258.85 (275.39)</td>
</tr>
<tr>
<td>Video Game Play</td>
<td>48.10 (100.60)</td>
</tr>
<tr>
<td>Handheld Video Game Play</td>
<td>24.48 (54.54)</td>
</tr>
<tr>
<td>Book Use</td>
<td>246.66 (241.13)</td>
</tr>
<tr>
<td>Computer (non-Internet) Use</td>
<td>43.63 (74.99)</td>
</tr>
<tr>
<td>Internet Use</td>
<td>51.32 (141.80)</td>
</tr>
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</table>
Table 2

Correlation Matrix for Model Variables

<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Central</td>
<td>1.00</td>
<td>0.77*</td>
<td>0.49*</td>
<td>0.65*</td>
<td>0.26*</td>
<td>-0.18*</td>
<td>0.11</td>
<td>0.30*</td>
<td>0.42*</td>
<td>0.52*</td>
</tr>
<tr>
<td>2. Incidental</td>
<td></td>
<td>1.00</td>
<td>0.41*</td>
<td>0.60*</td>
<td>0.32*</td>
<td>-0.04</td>
<td>0.004</td>
<td>0.35*</td>
<td>0.31*</td>
<td>0.52*</td>
</tr>
<tr>
<td>3. Inferential</td>
<td></td>
<td></td>
<td>1.00</td>
<td>0.58*</td>
<td>0.30*</td>
<td>-0.02</td>
<td>0.06</td>
<td>0.41*</td>
<td>0.28*</td>
<td>0.49*</td>
</tr>
<tr>
<td>4. Educational</td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
<td>0.38*</td>
<td>-0.07</td>
<td>-0.11</td>
<td>0.45*</td>
<td>0.48*</td>
<td>0.80*</td>
</tr>
<tr>
<td>5. Story</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
<td>0.002</td>
<td>-0.05</td>
<td>0.16*</td>
<td>0.19*</td>
<td>0.31*</td>
</tr>
<tr>
<td>6. Experiment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
<td>-0.01</td>
<td>0.13</td>
<td>-0.16*</td>
<td>-0.04</td>
</tr>
<tr>
<td>7. Control</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
<td>-0.16*</td>
<td>0.06</td>
<td>-0.09</td>
</tr>
<tr>
<td>8. Dora</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
<td>0.14</td>
<td>0.43*</td>
</tr>
<tr>
<td>9. Child</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
<td>0.48*</td>
</tr>
<tr>
<td>10. Educ.</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.00</td>
</tr>
</tbody>
</table>

*Note.* N = 172

*p < .05


<table>
<thead>
<tr>
<th></th>
<th>Central Comprehension</th>
<th>Incidental Comprehension</th>
<th>Inferential Comprehension</th>
<th>Educational Comprehension</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>B 95% CI</td>
<td>B 95% CI</td>
<td>B 95% CI</td>
<td>B 95% CI</td>
</tr>
<tr>
<td>Fixed components</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>-.57 [-3.48, 2.33]</td>
<td>.44 [-1.41, 2.29]</td>
<td>-1.36 [-3.91, 1.18]</td>
<td>-2.23 [-6.64, 2.17]</td>
</tr>
<tr>
<td>Story Schema</td>
<td>.29* [.06, .51]</td>
<td>.27* [.12, .42]</td>
<td>.33* [.13, .53]</td>
<td>.57* [.21, .94]</td>
</tr>
<tr>
<td>Experiment Control 1</td>
<td>-.76* [-1.39, -1.13]</td>
<td>-.12 [-.54, .29]</td>
<td>-.08 [-.62, .46]</td>
<td>-.45 [-1.42, .53]</td>
</tr>
<tr>
<td>Experiment Control 2</td>
<td>.75* [.12, 1.38]</td>
<td>.15 [-.26, .56]</td>
<td>.52 [-.02, 1.06]</td>
<td>-.42 [-1.40, .55]</td>
</tr>
<tr>
<td>Dora Familiarity</td>
<td>.18* [.09, .28]</td>
<td>.13* [.07, .19]</td>
<td>.23* [.15, .31]</td>
<td>.23* [.07, .38]</td>
</tr>
<tr>
<td>Child Age</td>
<td>1.54* [.88, 2.20]</td>
<td>.68* [.26, 1.11]</td>
<td>.75* [.18, 1.33]</td>
<td>1.43* [.31, 2.55]</td>
</tr>
<tr>
<td>Educ. Content Pretest</td>
<td>-- --</td>
<td>-- --</td>
<td>-- --</td>
<td>.81* [.67, .94]</td>
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<tr>
<td>Variance of random components</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Intercept</td>
<td>.20* [.02, 2.48]</td>
<td>0 [0,0]</td>
<td>.27* [.05, 1.40]</td>
<td>.08 [.00, 906.32]</td>
</tr>
<tr>
<td>Residual</td>
<td>4.13* [3.29, 5.18]</td>
<td>1.84* [1.48, 2.27]</td>
<td>3.04* [2.43, 3.81]</td>
<td>10.14* [8.11, 12.65]</td>
</tr>
<tr>
<td>Intraclass Correlation</td>
<td>.05 [0, .16]</td>
<td>.00 [0,0]</td>
<td>.08 [.00, .20]</td>
<td>.01 [.00, .08]</td>
</tr>
<tr>
<td>-2 Log Likelihood</td>
<td>738.53</td>
<td>592.79</td>
<td>689.77</td>
<td>887.77</td>
</tr>
</tbody>
</table>

*Note. N = 172 for all models

*p < .05